SYMPOSIUM ON MALARIA

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THE MALARIA PROBLEM IN THE SOUTH*

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The National Mal a Comm ttee has met annually nce 1916 Its purpose is to affo d tho e directly or d rectly intere ted n malaria c nt l an opportunity for d cu ng the problem invol ed It b ngs together field investigat s fi ld worker who are actually ap ply g the control mea q d th e intere ted from human tarian or economic tandp t By having re port ob ervat n e perie ce progress nd plan pre ented a d l cu sed t s e pected that th cont l mea ures will be more sci ntifically econo i cally and quickly applied The ub committees have been formed th year as fa a practicable f men actually enga ed in invest gat g or controll ng the di ease Th y hould be able it wa thought to de ote more time than others could to comm ttee ork The reports and dis cus ions of others however part cularly those who have prev ou ly e ed on th ub comm ttees have been mo t valuable It i h ped that all who can whether on the sub committees or ot ill participate in the del bera t ons and thus promote the aim of the National Malaria Committee

The country s p e ent malaria p oblem as reflected by mortality tat t cs as admirably set forth for state and count es by Doctor Maxcy at the 192 meet ing f the Committee a d published in the P bl c Health report of May 5 1923 He hows that n 19 1 and the two years immediately preced 520 cou ties in 16 states (9 in Alabama 52 n Arkans s 4 in Cali forn 41 n Florida 70 in Georgia 9 in Ill nois 6 in Kentucky 55 in Lou na 4 in M ss ippi 11 in M ouri 6 n North Carol na 20 n Oklahoma 6 in So th Carolina 27 in Te nes e 64 in Texas nd 6 in West Vi gin) rep ted a mo tality rate of more tha one death per 10 000 inhabitants The perce t ge of counties n th re p tive tates having a g nificant malaria probl m aried from 5 per cent n Kent cky to 90 per cent in M ss ssipp and the p o p rt on of the tate s popul tion ncluded in such coun ti s r ged from 1 per cent in Cal fornia to 9 per c t n M ssi ppi In Arkansas Flor da Lou siana and Missi ssippi approximately three fourths of the populat on live in counties having a s gnificant amount of malar a In a few counties of Arkan as and Florida the rate was 15 per cent per 10 000 and in three or four of them it exceeded this rate In five states (Cali fornia 1 per cent Illinois 3 per cent Kentucky 5 per cent M souri 6 per cent and Virginia 3 per cent) the malar ous counties i clude only 6 per cent or less of the total populat on The figures quoted from Doctor Maxcy s art cle reveal that in each state the malaria u uall is local zed With n the count es moreover the di ease i not uniformly d stributed but generally is focal in character

The d tribution inc dence and severity of malaria throughout the country have stead ly decl ned since the Civil War The death statistics for the New England states and cities showed in 1890 and 1900 a fairly hea y toll from malaria The mortality statistics for New York C ty in 1881 howed a death rate of 4 2 per 10 000 f om malar a[1] and the rate did not fall below 1 per 10 000 until 1890 The state of New Jersey in 18 9 had a rate of 2 6 per 10 000 which d d n t dr p b low 1 per 10 000 until 1898 Indiana had a rate ex ceeding 1 4 per 10 000 prior to 1900 The di ease is no l nger con idered of any public health gnificance in these area Similarly it has gradually eceded o er an ext n e area includin the Middle Atlantic and Middle W stern tates so that now only 16 states con ta n countie in wh ch the d sea e may be regarded as of publ c health importance

A number of factors have probably contr buted to the r sult but the factor of greatest importance has been drainage for the purpo e of reclaiming lands for ag cultural purposes The relative importance of thi and other operating factors has not been definitely determined However t is reasonably certain they are at work n many of the 5 0 malarious count es wh ch Doctor Maxcy enumerates

Such forces as may have been operating against ma l r a in the South have been systematically stimulated durin the past ten years by public health agenci s

(1) Stud es have been made of the prevalence d s tribut on and cha acteristics of the disease of th hab t and relat ve importance of the three prevailin species of anopheles mosqu toes of methods for d ag nos g and econom cally measuring the amou t of ma lar a in a g ven commun ty of the efficacy and public health alue of diffe ent plans for the cure of the dis ease and the conom c feasibil ty under the varying cond t ons encountere l of apply ng individually and collectively ma y of the methods of control that have been advocated

(2) The educat onal vork w th regard to the d sea e by the federal state and local agencies has been ex te i Literatu e and other educational material have

*Ch m Ad N tl l M la Comm ttee (C fer M l) m et g tly w th S ther M d l A oc t Fi htee th A l Meet g New O le L N 24 2 1924

1 Th t ph wh b l m y f th d th in New Y k C ty ported f 1881 as d to m laria w H d t typh id f

been distributed and children have been taught in many schools the elementary fact regarding the disease Physicians teachers editors farmers and local organizations have shared in this phase of the work

(3) Practical demonstrations of control measures have been made The towns rather than the rural areas afforded the most favorable fields for obtaining satisfactory results They are compact in area in population and in wealth and the drainage problems are often minor in character After proving the feasibility of controlling malaria by drainage and other anti larval measures a few malarious towns at a cost within easy reach of the people and after showing that the procedures were practicable for most of the towns having a high incidence of the disease this type of work was taken up on a large scale during 1920 1921 and 1922 by the state and local health authorities of 12 states with considerable cooperation in personnel and funds by the Public Health Service and the International Health Board During this period 90 towns representing approximately 300 000 inhabitants were protected against malaria The outside agencies feeling that this phase of the work had been adequately demonstrated left its maintenance and extension to the state and town health authorities and turned their support to the larger and more difficult malaria problem namely the *control of the disease in rural communities*

The rural malaria problem of the South has engaged and is now engaging the attention of the public health forces It is the basis for most of the reports and discussions that will be presented at this and other malaria conferences to be held in New Orleans this week The procedures which succeeded in the towns could be applied equally well in the rural districts if they were economically practicable The difficulty is largely economic The relationship in the towns between population and area does not of course prevail in the rural districts The situation calls for more exact knowledge along all the lines covered by previous investigations and for additional discoveries and for organizing training and maintaining suitable personnel to apply effective measures of control on a county basis with maximum directness The task is exceedingly difficult but undoubtedly is progressing toward accomplishment The problem in the South is much less difficult however than that found in the tropics where malaria bearing mosquitoes breed twelve months in the year the per capita area to be controlled is extensive and the per capita wealth is low The sub committee reports and the round table discussions you will hear today will dwell upon various recent activities mainly in the South reflecting progress

The rural areas of the South having an important public health problem in malaria are found in the coastal plains of all seacoast states from Mexico to and including Virginia The areas of high incidence extend further inland in the Gulf coast states than in the Atlantic coast states they are found along river basins especially the Mississippi and its tributaries where portions of the inland states of Arkansas Oklahoma Tennessee Missouri Illinois and Kentucky are *included*

The inhabitants are engaged in agriculture mainly In many of the counties 50 per cent or more of the people are negroes The climate is mild The average rural house is loosely constructed and is not easy to screen against mosquitoes However a considerable percentage of the farm homes mainly those occupied by white families are well constructed and many of them are screened Even though screening as a method of control presents difficulties it is useful and in *many localities is affording a considerable degree of* protection The various characteristics of the malarious areas under consideration are probably so well known by all who are present that a fuller description here is not warranted

The county is the only political unit which can maintain public health machinery to combat malaria and other diseases in the rural communities Experience in approximately 275 counties of 30 states shows that systematic educational effort will lead to an expenditure of fifty cents per capita for health purposes and that it will be continued and often increased if the personnel employed is reasonably efficient In some counties less than fifty cents per capita is spent *by the county for the county health organization* whereas in a few exceptional instances the amount has been as much as one dollar

In the usual county of 20 000 inhabitants on the per capita basis of fifty cents $10 000 yearly will be available for the county health organization an amount sufficient to pay the salary and traveling expenses of a health officer a public health nurse a sanitary inspector and salary of an office clerk When we think of three field workers serving an area thirty to forty miles square which has the usual health problems in addition to the one presented by malaria it becomes obvious that if headway is to be made the rifle and not the shotgun method of attack must be employed Malaria must be fought only where it actually exists Its distribution generally being focal in character control efforts should be concentrated on the foci As the size of the spleen in children seems to afford the most dependable and the most inexpensive index to the incidence and severity of the disease the health officers should master and employ the technic as a basis for determining the amount of malaria in a given area As the *Anopheles quadrimaculatus* is found to be the only mosquito transmitting the disease under natural conditions the fight should be centered upon this species All along the line the fight should be characterized by thoroughness and accurateness in defining the problem and by the employment of only those measures which will yield a large reduction of malaria for the money and energy expended

These principles to a varying degree have been introduced in about 40 county health organizations which are now featuring the control of malaria (26 of which the I H Board is aiding financially) The experience

has brought us to a point where there is general agreement as to the essential features which should be embodied in a malaria program for the use of a county health organization. As a plan for the county is listed for discussion at both malaria conferences being held here this week I shall not take it up except to say that I have seen five separate plans for the county. Three of them I submitted for comments to about thirty health officers and received comments from fifteen. All the plans and comments were in general accord as to essential features such as relationship of the state and county organizations, the personnel required by each, the malaria survey, the mosquito survey and the protective measures. Some difference of opinion which I think was more apparent than real related to the amount of laboratory and technical work the county organization should undertake and to the sources from which funds should be derived to meet the cost of drainage and other anti larval measures. These points will I hope be reconciled this week and a county plan adopted which will be acceptable to all the states. If this hope is realized and an acceptable plan can be formulated for obtaining and adequately training the personnel required I believe that rural malaria in spite of the difficulties it presents will yield with increasing rapidity to the forces at our command. It may be that there are areas which will not come under control until they are more densely populated and land values rise and a much more expensive program than now seems economically feasible can be instituted. Even the day when the economic situation will permit undertaking control measures far beyond our means at present may not be very far removed. The developments in Maryland, New Jersey and other Northern states as well as those which have occurred in the South during the past twenty five years should give encouragement.

SOME REMARKS ON THE MALARIA OF THE DUTCH EAST INDIES*

By E W Walch
Amsterdam Holland

I consider it a great honor to speak of the malaria in the Dutch East Indies before your meeting but I must confess that it would be perhaps easier for me though certainly of very little interest to you to say something about the malaria in the South of the United States as the great hospitality that I encountered everywhere when I was traveling there last summer enabled me to get an extremely valuable insight into your work.

Rather than to enter into details about the distribution of the malaria and its particular aspect in the several parts of the Malay Archipelago I should like to point out some of our problems in general and our way of examining them. In doing so I shall have to speak chiefly about investigations done in our colonies. I think it superfluous to emphasize how fully aware we are of the important work done by others.

Generally speaking malaria still remains a greater problem with us than hookworm disease. In the case of the latter disease we know approximately at least how to fight it. In the case of the former the period of investigations and research is much farther from being closed. One thing seems certain that is that the eradication will require enormous financial resources. The policy of our medical service therefore at the present time is to assemble as much data as possible in order to find out the most economical way of preventing and eliminating the disease.

There occur in the Dutch East Indies which according to one of our poets lie as a belt of emerald along the equator somewhat more than 20 species of anophelines of which only 3 or 4 nowadays are considered as carriers of importance. It is scarcely necessary to recall that after the years during which the medical men did not pay much attention to the existence of different species of anopheles there came a period in which due largely to the work in the Far East of Stephens and Christophers, Watson, Walker and Barber, Stanton and in our colonies Swellengrebel and Schuffner it was clearly recognized that certain species were much more dangerous than others. This often enabled the health officer to concentrate his activities against one species only. In the case of our most feared carrier the M ludlowi this species had more or less localized breeding places and this was a very lucky fact. As time proceeded and still more epidemics were studied it appeared however that the number of carriers in nature was greater than was first thought and the interesting fact was disclosed that certain species which were considered as practically harmless under certain circumstances difficult to define could be responsible for epidemics. Among those the M sinensis and the C kochi might be mentioned. This question is closely related to the fact that certain species which are important carriers in the Federated Malay States just across the Strait of Malacca in Sumatra until now have been of little practical importance for example the M umbrosus.

These facts are difficult to explain. Let us consider the sinensis. Especially in respect to the subtertian fever until recently it was discarded as a carrier though experimentally it had been infected as high as 50 per cent (average 4 per cent) with this form of malaria by Swellengrebel and Schuffner.[1]

The first chart however (Fig 1) will show you an epidemic occurring among 800 coolies in a coconut plantation near the sea consisting of a good many cases of subtertian that was chiefly occasioned by this anopheline. (In this map is reproduced in the bottom diagram the parasite and spleen indices of the adult population and in the two upper diagrams is shown th

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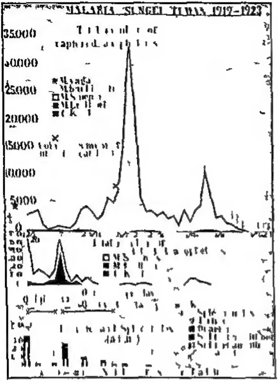

Fig 1

number of anopheles captured every four weeks and the result of their dissection)

Can we find any reason for this variability in behaviour? Is it due perhaps to a variation of the feeding habits of the anopheles? Will the sinensis as a rule attack especially animals and will it only occasionally prefer human beings? In the beginning it seemed as if the latter might have occurred here. We had placed 3 buffaloes each in a small closed stable provided with mosquito traps instead of windows round one group of dwellings and only few sinensis were caught in the stables (4000 against 135,000 in the coolie lines). But later when some 15 cattle were put in an open stable they attracted nearly half of the sinensis. Apparently it was chiefly a question of the relative numbers of men and animals. If there were only enough animals of an attracting kind present the sinensis visited them in large numbers.

Turning now to the second graph (fig 2) which represents an epidemic in rice field areas (Javanese Sawah) we find sinensis infected to a much higher degree (at times nearly 22 per cent against a maximum of 6 per cent in the first epidemic) but here again when later on we put buffaloes in an open stable near the dwellings they attracted the sinensis to a marked degree. One buffalo for about 20 men proved here to be able to divert nearly all the anopheles from the men. In these two cases the sinensis were not very prolific. I must state that in the future to make such observations complete it will be necessary to carry out the test of King and Bull to determine whether the blood contained in the stomach of the mosquito is human or animal.

Another possibility that might explain why the sinensis sometimes is an important carrier and on other occasions seems to play no role in the transmission is that there are two varieties of sinenses of different susceptibility. The sinenses in the cases under discussion were of the vanus type. In the second epidemic more attention was paid to this point. The most important differences of the females of the M sinensis type and the vanus variety are to be found in the wing. The yellow spot on the costa at the end of the subcosta does not reach as far as the first longitudinal vein when we have to deal with a vanus (fig 3) but does so when we have to deal with a sinensis (fig 4). The vanus has however in many instances an accumulation of yellow scales on the corresponding part of the first longitudinal vein (fig 5). The above named spot on the costa as a rule is smaller on a vanus than on a sinensis (Christophers and Khazan Chand[2] Swellengrebel[3])

Another point that is clearly illustrated by the first epidemic that we referred to is that in order to get a good idea of the cause of a malaria epidemic so far as the anophelines are concerned it is generally necessary to dissect a great number of them during a period of time that is sufficiently long. When (in fig 1) we compare the diagram of infected mosquitoes with that of the malaria among the coolies it immediately appear that the sinenses and the ludlowi each had their own turn in which they were the principal carriers as in the beginning the sinensis was the cause whereas the second aggression of the malaria was due to a high summit in the number of infected ludlowi.

Furthermore while studying an epidemic it is not sufficient to mention alone the natural infection index of the anopheles but it is necessary also to reckon with the total number of captured anopheles in order to ascertain the relative importance of the different carriers. In the first epidemic it appears from the following table that though the infection index of the sinensis is lower than that of the other two carriers still the former is the most important because of its far greater numbers.

	No dissected	No infected oocysts in stomach	per cent infected
M sinensis (1919 1920)	14599	151	1 1
M ludlowi	422	65	14
C Kochi	229	12	5 2

It is worth while considering also the number of oocysts per infected mosquito. Swellengrebel and Schuffner are of the opinion that a high average of oocysts per infected mosquito will denote as a rule a severe epidemic. Schuffner who worked about 25 years in Sumatra furthermore defends the view that when a highly susceptible anopheles is present and at the same time a sufficient number of gametocyte carriers the conditions for a malignant malaria are created. Such a situation is likely to occur when a group of new

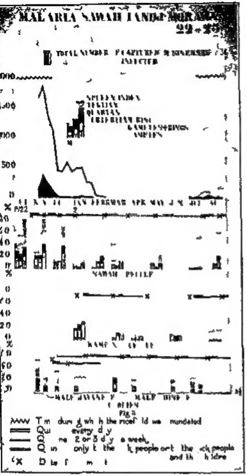

Fig 2

comers enter an endemic center In such a region the anopheles generally have a small number of cysts and as we shall see later on the number of gametocytes also is relatively small But as soon as recent infections in the newcomers develop the number of gametocytes rises The mosquito under such conditions has the opportunity to develop a great number of cysts and afterwards of sporozoites Schuffner now makes the plausible supposition that a greater number of sporozoites injected into the blood of a man will occasion a more severe malaria than an injection of a smaller number of sporozoites The result is that there will develop cases with many parasites including many gametocytes and the circulus vitiosus which will give rise to a severe epidemic is produced In this respect it is interesting to note that in the first epidemic apart from the higher infection index the ludlowi also showed its greater individual danger by the larger number of cysts that it possessed From the following table can be seen that on an average an infected ludlowi had thrice as many cysts as an infected sinensis

	No infected	Total No of cysts	Av No of cysts per inf mosquito
M ludlowi	56	2835	51
M sinensis	122	2077	17

Before leaving the general discussion of the carriers as it was illustrated by the two graphs I should like to draw your attention to the fact that in both cases at the close of our observations another mosquito took the place as the prevalent species the M vaga As this anopheles is of very little importance as a carrier (we dissected several hundred of them without finding any infected) this change was a most favorable one In the second epidemic after what we had observed in the first we were inclined to try by introducing larvae of the vaga to supplant the sinensis Ross already had suggested such a measure Nature however in our case accomplished the change

A study of the relation between the properties of the water the food that it contain and the occurrence of a certain species of larvae promises to explain at least something of those changes In this respect I need not draw your attention to the investigations in which Dr Barber is engaged and which he gave me an opportunity to see last summer

If I had to state in a few words the gist of what has so far been discussed I should say that it is that each epidemic has to be studied for itself and the time for broad generalization has not yet come

Having thus considered the role of the anophelines we will now pass to the human factor in malaria transmission in so far as its carriers are concerned By investigating the people exposed to the disease the tendency today is more and more to examine as a routine both blood and spleen As far as the former is concerned we believe it a good practice to make when possible on one slide a thick drop as well as a thin film If so desired both can be stained at the same time For diagnostic purposes it is not necessary to fix the thin film before staining The thin film is only looked at if the examination of the thick drop leaves some doubts as to the nature of the parasites

The best method to measure and record the enlargement of the spleen is in my opinion is the one described by Christophers in his usual scientific way at the last congress of the Far Eastern Association of Tropical Medicine at Singapore I know no better way than to refer you to the transactions of that meeting and to his papers in the Indian Journal of Medical Research vol XI No 4 1924 The principle is that the enlargement of the spleen is measured in centimeters and that at the same time some anthropometric measurement (sitting height nipple umbilicus line) is taken that indicates the size of the individual and allows of correction Furthermore it is pointed out that due to the variation in the position of the costal margin the method of measuring the spleen by the amount of projection of this organ below this margin can give

only vague information It seems to me that it is especially of importance in countries where there are a great number of considerably enlarged spleens Christophers therefore suggests determining the position of the spleen by taking two measurements (a) the distance of the apex of the spleen from the umbilicus (b) the distance of the same point from the middle line of the body So far the method has been worked out only for children

In recent years Schuffner in our colonies has recommended including in the study of the epidemiology of malaria the examination of the blood and spleen of adults as well as children We do not intend to say that when a rapid orientation is desired it is necessary to carry out all these methods of investigation For a rapid survey no method is superior to the splenic index of children The value of this procedure under the conditions met in the southern part of the United States has been dealt with in an authoritative way by Darling at the meeting of this association in 1923 In the Dutch East Indies all information that is available should be used on account of the seriousness of the problem a complete examination is indicated Refer for details to Schuffner's article in the Reports of the Dutch Indian Civil Medical Service of 1919 (part IX) I should like to mention here his most important conclusions I must emphasize however that I do not wish to submit them as definite facts but only as a valuable basis for further investigation and discussion

Schuffner gives the following differences between the blood picture and the splenic indices in the case of an acute outbreak of malaria and a really endemic malaria

(1) In the case of the former the spleen rate usually is not very much higher than the parasite index Sometimes even the parasite index will exceed the splenic index In case of the latter the parasite index is very much lower than the splenic index The former will be for instance one third or one fourth of the latter

(2) In so far as the subtertian is concerned the typical epidemic is characterized by a high percentage of gametocyte (crescent) carriers perhaps 75 per cent whereas in endemic malaria this percentage is low (about 25 per cent)

(3) However in the above named respects a declining epidemic would not differ from the chronic endemic malaria But in the case of the former and of the acute outbreak as well the children and adults have about the same parasite index whereas in the endemic area the parasite index will decrease with increasing age

The accompanying charts (fig 1 and 2) will show you a practical application of the methods of examination described above You will notice that for obvious reasons the gametocyte carriers of the subtertian are indicated separately * In the first epidemic where in the chart only the malaria of the adults is represented we had to deal apparently with an acute outbreak the parasite index was higher than the splenic index There was a large percentage of crescent carriers Through the influence of the quinin the picture changes the parasite index diminishes more rapidly than the splenic index and the latter is now bigger than the former As soon however as the ludlowi occasions a recrudescence the parasite index rises again above the splenic index and the relation of the two is again that of an acute outbreak **

Turning now to the second epidemic where the malaria of men women and children has been represented separately we see that in the beginning the people of the rice field sections (sawah) showed a somewhat complex picture The children have a parasite index that equals the splenic index We should be inclined therefore to think of an acute outbreak In accordance with this fact in adults the parasite index is still relatively high (about 3/4 of the splenic index)

But the relative number of crescent carriers was not very high (somewhat more than half the total number of subtertian patients) and the percentage of attacked children is higher than that of the adults suffering from malaria The latter fact especially would not be observed in an uncomplicated acute outbreak It is explained however when we consider that the adults had already taken some quinin voluntarily

The relatively low number of crescents might indicate that the epidemic had not started very recently That this was indeed the case was clearly demonstrated by the slow way in which the spleens (especially of the children) diminished in size after the administration of quinin

In figure 2 the results are shown of the examinations of Javanese coolies who first worked in the rice field of the Chinese who worked later on in its neighborhood and of the inhabitants of a native village (Malay kampong) situated quite close to the rice field The administration of prophylactic quinin (⁄ gram hydrochlorid 3 or 2 days a week) to the Chinese especially in the beginning was not very effective This was due however largely to the fact that they did not like taking quinin when they did not feel sick and upon inquiring we learned that a good deal of the medicament did not pass their throats To the same cause may be attributed the fact that the children of the rice field scarcely improved in the beginning As soon as the treatment however was carried out under daily control of the European supervisor the children improved rapidly (December January 1923)

The effectiveness of the quinin is also clearly demonstrated when we compare the village people with the laborers of the rice field in the month of January 1923 The former were heavily infected the latter had only a relatively small number of parasite carriers The conditions of environment were quite the same

* O[illegible] the [illegible] h[illegible] th[illegible] peopl[illegible] wh[illegible] [illegible] from thos[illegible] w[illegible]th [illegible] only Wh[illegible] [illegible] this group ought to be small I[illegible] [illegible] trol [illegible] effect of q[illegible]

** It will be n[illegible] ed th[illegible] t th[illegible] [illegible] Schuff[illegible] [illegible]ited [illegible]

the only d fference between the two groups was that the inhabitants of the rice field had already taken qui nin for some months and the other people scarcely any at all

This brings us to a discussion of the therapeutic measures I need not speak here about drainage oil ing etc the effectiveness of whi h nobody will take exception I should like to mention however the ques tion of catch ng adult mosquitoes under certa n condi tions as a means of control Though advocated by such men as Ross Gorgas and LePrince it does not get per haps the consideration which it merits In our colonies Schuffner has defended it strongly Personally espe cially when having to deal with well disciplined native laborers I have always practiced it In the first epi demic in the beginning mosqu toes were caught by a small mosquito br gade only but starting in May 1921 the whole population including ch ldren was armed with catch tubes made of bamboo and a small reward was offered for each captured anopheles The effect was very striking Before this the greatest number of anoph eles we obtained in one month was 6000 but after the new scheme it mounted at once to 33 000 (in a popula tion of only 800) Before May of course there were some variat ons but such a big increase followed by an equally big fall (down to 3 4000 a month under inten sive catching) had never previously occurred We strongly bel eve that this fall was the result of the an nihilat on of so many adult females

In the second ep demic we started immediately the intens ve catching From the chart i to be seen that there was a substant al drop in the number of anopheles before the rice field was drained

Another po nt which we have already touched upon but which mer ts further cons deration i the pro tecti e role of animal The general tendency in the Dutch Ea t Indies is to believe that the cattle have indeed value in this e pect As already stated above t seems that the relation between th number of cattle and of the men who are to be prot cted is an imp tant factor In Belawan the harbour of Medan (East coast of Sumatra) Schuffner and Hylkema[4] succeeded in protecting about 80 men by 1 buffalo our mo t at tractin an mal They had to deal with an epidemic of ludlowi but the sinens s also entered the stables rea lily In our first ep dem c 1 b ffalo was not able to d vert suffic ently the mo quitoes from about 100 men Even when we brought a buffal fro i Belowan where he had done good serv ce to our coco ut plantat on he did not prove suff c ently attracting in h s new env ronment But lat r on a g oup of cattle 5 times s big did the wo k very satisfacto ly This whol que tion however is still in the phase of investigation Re cently Ma gkoewinoto[5] in two series of experiments conducted in different places and each extending over a period of from about 60 80 days ob rved that on one of these occasions the buffaloes as compared to men were much more attractive fo the same spe es of anopheles (M acon ta) than th other time

This br ngs me to the end of this brief sur ey I feel certain that I could not g v you ne ly so good an idea of the way in which we study the malaria over there as I obtained of the work done here during my stay in this country If however it has been of only some interest to you my aim is never theless ecured

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MEDICAL RESEARCH IN MALARIA*

By R W Hegner Ph D and Associates
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The following is a brief outline of the work done durin the past year by members of the Department of Med cal Zoology School of Hygiene and Public Health Johns Hopk ns Un versity

(I) Efforts have been made to discover a thera peut c a ent equal to or better than quinin This ork has been in progress since July 1 19 3 under the d rection of Dr Hegner with Dr G H Boyd n har e from July 1 19 3 to June 30 19 4 and Mr E nest Hartman in charge since July 1 1924 Syn thetic qu nin derivat ves have been obtained from D Ja ob of the Rockefeller Institute and these have b en experimentally used on canaries sufferin from bird malar a The re ult des red is to find an agent that w ll br ng about the destruction of all of the p rasites in th body of the host and hence prevent re ap e

(II) The relat on of malarial organ sms to mosquitoes nature has been stu lied Dr F M Root spent the summer of 19 3 at Leesburg Georg a d ssectin mos q itoes n o der to determine which species actually t ansm t malaria H re ults are not yet available

(III) Complement f xation tests ha e been attempted f r m laria carr ers The work was begun by Drs H C Clark and R W Hegner at Tela H nduras during the summer of 1924 and will probably be continued during the coming chool year

* R p t f m M mb f S b Comm tt M d l Re- h N ti l M l C mm ttee (C f n M l) meet g j i tly w th S th M d l A t E ht th A l Meet g N w O l L N 4 19 4

PROBLEMS FOR FURTHER STUDY

(I) Studies should be made of the life cycle of mala ria parasites in the vertebrate host. Questions of im portance are

(1) Where are the parasites located in the body at various stages in the course of the infection and in what stages in their life cycles? The distribution of the stages is known to differ in falciparum from that of the other two species Why do specimens of falciparum clog up the capillaries? What factors bring about these differences in distribution etc and what are their relations to virulence latency relapse etc?

(2) Is the malarial parasite inside or outside of the red cell? In all stages? Do the parasites migrate from one cell to another?

(3) Is there a filterable stage in the life cycle e pe cially during the period between relapses when no para sites can be found in the peripheral blood?

(4) When and where does the change take place from schizonts to gametocytes? Factors? Does the sex of the host have any influence on the production and sex of the gametocytes?

(5) If the falciparum disappears and vivax takes its place as is claimed by some what are the stages in this change and how is it brought about?

(II) Studies are likewise needed of the life cycle of malaria parasites in mosquitoes

(1) In nature what is the influence of temperature moisture latitude and altitude on porogony in the mos quito? Length of different sta es? Numbers of oocysts? Numbers and distribution of porozoites?

(2) Effects of starvation diet etc on stages in life cycle in mosquitoes? Duration of stages? Numbers? Length of infectivity?

(3) Are stages in sporogony as worked out by Grassi correct?

(4) Does the environment of the mosquito or its larva or pupa have any effect on its infectivity? Hu midity temperature salinity of water alt tude?

(5) Are different species of mosquitoes responsible for the appearance of vivax early and falciparum later in the season?

(6) Are mosquitoes responsible for the local appear ance of malaria? Pla modium malariae may be abun dant in a spot surrounded by vivax and falciparum but free from malariae

(7) Do mosquitoes suffer from infect on? Do non infected mosquitoes live lon er than infected mosqui toes?

(8) Effects of hibernation and estivation on sporog ony? Do oocysts degenerate?

(9) How many gametocytes are necessary to infect mosquitoes?

(10) How many oocysts are necessary to produce an infective mosquito?

(11) Are mosquitoes susceptible to mixed infections? Can they transmit them to man? If they can does this prove plurality of species?

(12) There exist relatively impossible mosquito hosts Why is there not infection in all hospitable hosts?

(III) Problems of relapse in malaria are concerned with

(1) Parthenogenesis What is the status of this phe nomenon?

(2) Do old red cells become immune? Are young cells more frequently parasitized? Would relapse result from rapid increase of young cells?

(3) Is relapse due to changes in blood plasma which make it easier for merozoites to parasitize cells or to changes in the inhibiting power of leucocytes?

(4) Can relapse be brought on after administering quinin?

(5) What is responsible for latency i e the period between inoculation and symptoms?

(6) The changes in the body that are responsible for relapses may be determined by determining the con stant factor of altitude cold etc. and provocatives

(7) Is there a resistant stage or unknown stage of parasite that brings on relapses?

(IV) The species problem is in many ways unsettled

(1) Is there a *tenue* stage in the life cycle of fal ciparum?

(2) Are the species in man and primates the same?

(3) How many human species are there?

(4) Are there two species or subspecies of falciparum?

(5) If a mosquito is fed on mixed infection will it transmit a mixed infection?

(6) Is virulence related to different races of para sites?

(V) What is the relation of parasite to the resistance of host and blood reactions?

(1) Is immunity acquired?

(2) Is complement fixation in malaria with antigens prepared from the cultures or organs?

(3) What is the relation between the number of par a ites in the blood and clinical symptoms?

(4) What brings about clinical symptoms?

(5) Does dengue give immunity?

(6) What is responsible for the pathogenicity of fal ciparum?

(7) Do provocatives increase asexual reproduction or force parasites out into the blood?

(VI) What are the effects of quinin on parasites?

(1) Effects on various stages of different parasites in blood?

(2) Quinin prophylaxis under controlled conditions

(3) Effects on parasites in non quininized cases after various types of doses

(4) Effects on mosquitoes of ingesting blood contain ing parasites as well as quinin

(VII) Identification of carriers might be possible through study of

(1) Spleens
(2) Complement fixative
(3) Leucocyte method
(4) Thick and thin films

MEDICAL RESEARCH IN MALARIA*

By S T Darling M.D
International Health Board
Leesburg Ga

During the years of 1923 and 1924 there has been in operation by the International Health Board at Leesburg Georgia a Station for Field Studies in Malarial Control Here observations and studies are being made on the natural history of malaria as it occurs among people in the district Studies of the anopheles species and their habits are also being made Beside these studies instruction is given in malariology to medical officers and others interested in the subject

Leesburg Georgia was selected because of the severity of the malaria in the district for it is only possible to study malaria and give instruction on the subject where the disease is abundantly present at all times during the warm season and where latent malaria is present during the cooler months Efforts at first were directed to ascertain the specific nature of the problem in the locality afterwards to extend the investigation outwards into other regions until the problem of malaria in the Southern States has been more or less envisaged

Experience elsewhere has shown that because of differences in the mosquitoes and their habits and in climate and topography and because of economic reasons each region presents peculiarly specific problems There fore it was decided to take little or nothing for granted but to investigate as carefully as possible the problems of the locality for if there were specific problems calling for special methods of control waste of money time and effort might be avoided by carrying out the control measures in places only where they were needed

METHODS OF STUDY

There was found to be considerable advantage in working continuously in the locality through two rounds of seasons for in this way a most intimate knowledge of all phases of the problem is obtained Inasmuch as the first year of residence was a year of heavy rainfall in which breeding and mosquito density were abundant while in the second year there was a prolonged dry season during the summer and fall there were opportunities for studying the effect of rainfall and drought on anopheles production and on malaria

Malarial surveys were made in the schools and on the plantations. Careful histories spleen examinations and blood examinations were made A number of stations were established on the plantations and elsewhere for the purpose of measuring as accurately as possible the incidence and density of anopheline mosquitoes throughout the seasons Care was taken to select stations which would yield information in regard to the habits of all three species of anopheles Those which presumptively were transmitters of malaria as well as other suspected ones which are always found feeding on man An attempt was made in every case to trace the adult mosquitoes found back to their breeding place a matter of very great importance in malarial control work

Malarial Surveys—Malarial surveys were made at first at the schools for there the population is segregated and can be conveniently sampled and examined but as it was desired to compare the numbers of children whose spleens were enlarged and whose bloods were positive for malaria with those which gave a positive history the surveys were carried out later on the plantations where parents could be interrogated The plantations were visited children and parents were assembled and careful histories taken Spleen examinations were made blood was obtained for the hemoglobin test and to determine the incidence of infection At the same time adult mosquitoes were collected inside and under the houses and outbuildings and collections of larvae were made from all breeding places within flight distance of the premises Both white and colored children were used in the survey Children between the ages of two and twelve years only were used in the determination of the spleen index for the reason that it is slightly more difficult to determine splenic enlargement in children under two years of age and in those over twelve years than between these years and because in an endemic region splenic enlargement is less apt to occur after the age of puberty

The spleen becomes an important means for the detection and measurement of malaria from the fact that malarial infection is a condition in which on the whole the deeper viscera are more apt to be involved than the peripheral blood which latter sometimes represents an overflow from the deeper organs where the great drama is being enacted During infection mature and segmenting forms often retire from the peripheral blood to the deeper viscera After the administration of quinin the peripheral blood is more thoroughly cleared of parasites than are the internal organs particularly the spleen and bone marrow Even after apparent cure relapses often occur from the multiplication of parasites which we believe were lying in the blood spaces of the spleen and marrow The spleen enlarges during malarial infection and in relapse and it remains enlarged in cases in which parasites have to some extent become either very sparse or have disappeared from the peripheral blood In as much as plasmodia are more apt to be found in the deeper viscera than in the peripheral

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*Report of Sub-Committee on Medical Research National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La Nov 24-27 1924

CONDITION OF SPLEEN IN RELATION TO MALARIA INFECTION

Colored Boys and Girls Previous to August 1

Spleen	Negative	Palp. Insp.	Palpable	1 f. b.	2 f. b.	3 f. b.
Number of cases examined	267	17	104	20	23	15
Number of cases positive blood	30	4	30	8	[illegible]	11
Per cent of positive blood	11 3	23.53	28.84	40	56.5	73.33

blood the examination of a viscus like the spleen should give us more information as to the presence of infection than the examination of the peripheral blood when for the purpose of measuring malaria in any locality numbers of cases are considered. Spleen rates were determined at least twice on some of the plantations so that we could learn how the rates were influenced by seasonal changes in anopheles density. The spleens varied considerably in size and they were conveniently measured by the number of finger breadths which the lower margin was found to reach or extend below the costal margin. Various methods have been devised for the measurements of enlarged spleen but some are difficult to use for the reason that in the smaller degrees of enlargement encountered in the Southern States the spleen is not always found exactly in the same relation to the anterior axillary line. Sometimes its position is low down in the flank, at other times nearer the nipple line. On this account a simple method of measuring by finger breadths was used which was found to yield valuable information. Following is a classification of the degrees of splenic enlargement:

(1) Negative on deep inspiration

(2) Palpable on deep inspiration

(3) Palpable on normal inspiration but not 1 finger breadth below the costal margin

(4) One (1) finger breadth below costal margin on normal inspiration

(5) Two (2) finger breadths below costal margin on normal inspiration

(6) Three (3) finger breadths below costal margin on normal inspiration

A definite relationship was found to subsist between the size of the spleen and the amount of malaria as measured by the presence of plasmodia in the peripheral blood.

In the above table is seen a correspondence between splenic enlargement and the presence of plasmodia in the peripheral blood, for in a group of cases those presenting the higher degree of splenic enlargement are more apt to reveal plasmodia in the peripheral blood than those with the smaller degrees of enlargement, but it is to be noted that all enlarged spleens are of malarial origin and that the spleen palpable only on inspiration is indicative of malaria as well as the spleen two or three fingers breadth or more below the costal margin.

Method of Examination.—In communities where malaria is light and when during the cooler months the infection has subsided, spleens of the smaller degrees of enlargement only may be encountered. In order that this smaller degree of splenic enlargement may be detected for the better examination of any spleen and for the determination of the malarial index it is necessary to place the child to be examined in a recumbent position with the thighs and legs flexed. The clothing should be previously loosened so that the hand or fingers of the examiner may be easily and freely placed upon the bare skin of the abdomen. If the spleen is not palpable the child is instructed to take a deep breath. With the tips of the fingers of the right hand held just below the costal margin slight pressure is made just as the child takes a deep breath. At this moment if the spleen is enlarged it may be felt as it descends being pushed down by the diaphragm. Care must be taken not to press too deeply for then tension on the abdominal wall will prevent the spleen from being felt as it moves under the tips of the fingers.

Histories.—When histories were carefully taken and compared with the spleen and parasite rates it was found that the spleen rate corresponded more closely with the history rate than did the blood rate, although when the malaria became severe after the first of August blood rates reached a higher level but never equalled the spleen rate or history rate.

In taking histories there is some difficulty in interpreting the statements or replies of the persons questioned. Straightforward histories of chills and fever presented no difficulties, but among persons in regions where malaria was light, histories of fever, headache and fever or merely headache would sometimes be elicited. Upon examination of blood specimens, positive cases of malaria were detected in some persons who gave a negative history. In view of the difficulties of eliciting from children or from parents histories which may be relied upon and in view of the correspondence between positive histories when carefully taken and of spleen rates from the same group of persons and the findings recorded here, it is recommended that the spleen be used whenever possible as an index in the measurement of malaria.

Blood Examination and the Parasite Rate.—The blood smear merely represents a very small sample of the blood which may be infected. Infections may be light or heavy. Plasmodia may be segregated in the deeper viscera and there may be few or many of them in the peripheral blood. In our experience technicians have more confidence in their findings when using the thin film for diagnosis. A record of the time taken to detect

COMPARISON OF THE HISTORY, SPLEEN AND BLOOD RATE OF THE NEGRO CHILDREN

Month	Histories Total No.	Histories No. Pos.	Histories Per Cent Pos.	Spleen Total No.	Spleen No. Pos.	Spleen Per Cent Pos.	Blood Total No.	Blood No. Pos.	Blood Per Cent Pos.
July, Aug., Sept.	483	190	39.3	483	181	37.4	483	109	22.5
Oct. and Nov.	339	2	65.5	339	234	69	339	178	52.5

plasmodia and the time spent on the so called negative slide has been kept for the purpose of ascertaining the average length of time which should be spent on a slide before it is called negative. Slides which have been called negative on one occasion have revealed plasmodia upon a more thorough search. A negative report therefore is a qualified and relative one and means nothing more than that during the time spent in the examination of the slide by a certain microscopist plasmodia were not detected.

Hemoglobin.—Very interesting and valuable information has been elicited from the analysis of hemoglobin records of the children furnishing the spleen and parasite rates in the malarial survey. For the purpose of valid comparisons it is necessary to divide the cases into age groups. When this is done a striking correspondence between anemia and splenic enlargement is seen: for the greater the degree of splenic enlargement the lower is the average hemoglobin of the groups. This is particularly true in the age groups 2 to 5 years. When the hemoglobins of the whites are compared with those of the negroes it is found that the hemoglobins of the negroes are set 9 to 10 points lower than that of the whites and this is due almost entirely to the malaria from which they suffer.

Natural History of Malaria (Givens Experiment).—An extended series of observations has been made to ascertain just what is the natural course of events in a family all members of which are infected naturally with malaria. They lived in an environment unprotected from the anopheles quadrimaculatus which was breeding close by and had little or no quinin medication except for a period during the test and they were probably suffering from some undernourishment.

This study was one of chronic malaria as manifested by clinical symptoms, splenic enlargement, anemia and by the presence of plasmodia in the peripheral blood. A family of negroes including the mother and four children was examined at weekly intervals for a period of more than a year. At each examination individual histories were obtained, the spleens of the children were palpated and measured by the method described above, the hemoglobin percentages were estimated using a Dare hemoglobinometer and blood smears were taken for the estimation of the numbers of gametocytes and parasites per 500 fields.

The mother was 32 years of age; the children were 9, 6, 4 and 2 years respectively. There were two boys and two girls. They lived in an open house devoid of screens. Adult female anopheles quadrimaculatus mosquitoes had been caught inside the house. Three successive crop failures had reduced the family to poverty but the children did not appear to be grossly underfed. They were not infected with hookworms, two examinations for ova being negative. There was no history of syphilis and no evidence of it in any member of the family. They had had no acute infectious diseases during the year. The family appeared to be thoroughly typical of others in Lee County, Georgia.

Symptoms.—There had been comparatively few acute episodes during the year. The mother had had chills in the five months when her blood showed parasites. The girl age 9 had four chills during six months while her blood was positive. For two weeks there was tenderness over the spleen. The boy age 6 had had no chills although his blood contained parasites for five months. The boy age 4 had had only one chill during twelve months when for a period of only two weeks his peripheral blood had been negative. He had had as many as 300 parasites per 500 fields without enough malaise to impress his mother sufficiently so that she would report it. The girl age 2 had had ten chills in twelve months, her blood being negative only four weeks of this period. She had had periods of fever and headache occasionally. All of the children appeared normal and none looked chronically ill.

Parasites.—From the time of the first examination in November 1923 until the beginning of an eight weeks treatment (standard treatment) in March 1924 each of these negroes had shown parasites in the peripheral blood. The numbers of parasites ranged from 300 per 500 fields to 1 per 500 fields and of gametocytes from 65 to 1 per 500 fields. The mother had had all three species of parasites in her blood. The girl age 9 had also had all three species in her blood. The boy age 6 had had only quartan parasites, the boy age 4 only subtertian parasites and the girl age 2 had had tertian and subtertian parasites. Some of the parasites found in the blood of this youngest child had on four occasions resembled the Plasmodium tenue of Stephens.

During the period of treatment the two younger children continued irregularly to show parasites including gametocytes, probably because the treatment was not given regularly by the mother. After the period of treatment the girl age 9 and the boy age 6 remained free from parasites in the peripheral blood up to the present, a period of eight months. The mother remained negative until October 1924 when she had at first many subtertian rings and then a week later many crescents in her blood smears. The two youngest children have continued to show the same types of infection after treatment as before.

Gametocytes.—Excepting for two weeks in March, two in April and three in May one or more members of this family have at all times been carriers of male and female gametocytes in sufficient numbers to be infective.

Hemoglobin.—In general the hemoglobin curve has inversely followed the parasite curve. In each case but that of the girl age 9 it reached its highest peak after four weeks of quinin treatment. In every case during treatment there was a rise in hemoglobin percentage for about four weeks and then a fall. The range in percentage of hemoglobin has been as follows:

Mother 64 to 89; girl age 9 56 to 88; boy age 6 65 to 90; boy age 4 46 to 87; and girl age 2 46 to 88.

Spleens.—The mother's spleen was not examined.

The children have had palpable spleens at all times. Those of the girl age 9 and of the boy age 4 have

ranged from palpable to the umbilicus that of the youngest child has always been large ranging from 2 finger breadths to pelvis and that of the boy age 6 was 2 finger breadths before treatment This was reduced to palpable on inspiration during treatment and has remained in that condition since Although the treatment caused all parasites to disappear from the peripheral blood of the girl age 9 it had very little effect on the size of the spleen In every case the size of the spleen has varied somewhat from week to week notable increase in size coming about a week after a notable increase in the number of parasites in the peripheral blood The spleens have always been moderately firm in consistency and never tender excepting for two weeks in the case of the girl age 9

An Experiment With the Standard Quinin Treatment—This was to ascertain the effect of standard quinin treatment in reducing the size of the spleen of children living in a malarial community and it developed out of a suggestion made to us by Dr M A Fort The experiment was conducted by selecting some 75 children in a malarious region in a neighboring county All the children had enlarged spleens and had suffered from malaria the previous summer The children were selected early in the spring and were divided in two groups 50 children were to receive the standard treatment and 25 were to be used as controls The controls had spleens of the same degree of enlargement and were brothers or sisters and lived in the same houses and under the same economic and environmental conditions as the experimental cases The children in both groups have been carefully examined at intervals of about a month since the experiment began Some of the results may be reported now

The standard treatment will remove plasmodium from the peripheral blood for as long a period as it is maintained During this time there is a progressive reduction in the size or mass of the spleen in each type of enlargement It is more marked in the larger sized spleens than in those palpable or palpable on inspiration In the control cases untreated by quinin there was a slight increase in the size of the spleen while at the same time the spleen of those under treatment was steadily reduced in volume The quinin treatment was continued during a period of ten weeks Following its discontinuance there was noted a gradual increase in the spleen mass of all groups of cases

The increase in the spleen rate after the conclusion of treatment appeared not only in the treated group but among the controls as well This was due in part to new infection and undoubtedly in part to relapse because many of the spleens in the treated group had not been reduced by treatments to normal volume and such enlargement as persisted we believe is due in part to latent malarial infection During the course of the experiment observations were made which tended to show that hard work in the fields under the hot sun plowing or harvesting peanuts or other heavy crop provokes relapse in treatment cases even when plasmodia have been driven from the peripheral blood and that this economic factor militates somewhat against success in malarial control by the standard treatment Comparing the results of the experiment with standard quinin and with the quinin administered to the Givens family it is seen that the success is only attained when the quinin is given in proper dosage regularly by responsible persons

Blackwater Fever—Blackwater or hemorrhagic fever has been found to occur in many regions of severe malarial endemicity During 1923 there was an opportunity for observing several cases of this disease in Lee County During the year six deaths occurred Not all of these were seen or investigated but the histories elicited left little doubt as to the correctness of the diagnosis The cases occurred during late summer and fall when malaria throughout the county had reached a high degree of intensity They occurred on farms where anopheles quadrimaculatus was breeding abundantly where spleen rates among the negro children were high and in a number of instances where infected specimens of quadrimaculatus were found in the negro quarters All cases occurred among whites The disease presented no feature different from those seen in other countries

There was however one epidemiological feature which may have some significance In a number of instances houses were pointed out in which two deaths or several cases of blackwater fever had occurred in one family Inquiries elicited the information that sometimes these cases or deaths occurred within a short period of time In other instances a greater period of time had elapsed between the occurrence of the disease in a mother and son or grandparent and grandchild Usually these cases occurred on one farm or in one household so that severity of malaria in the immediate neighborhood might be considered as one of the factors This house or family susceptibility however taken in connection with circumstances just mentioned leads one to suspect that the hemolysis in blackwater fever may be due to an anti hemolytic mechanism rendered defective in certain familial groups of persons by attacks of malaria and that this peculiar defective mechanism is heritable Furthermore on account of the absence of this disease among pure blooded negroes many of whom suffer from malaria to the same extent as the whites who have blackwater fever and in view of the well known fact that races and individuals possess types of blood constitution there is a possibility that only a certain group of persons is susceptible to the disease and that this susceptibility is heritable

Treatment of Blackwater Fever—An important advance in the treatment of this disease would appear to have been made by Dr O L Cranford of Sasser and Dr O W Statham of Leesburg Georgia Dr Cranford first conceived the idea of treating cases of this disease with anti streptococcic serum believing that he was dealing with a disease upon which had been engrafted a streptococcus infection Dr Statham following Dr Crawford's lead has treated some thirty odd cases of the disease with a very low mortality rate His method of procedure is to discontinue quinin and give 20 c c of anti streptococcic serum at once sub

cutaneously Certainly in the hands of Dr Statham this treatment has given very much better results than have been obtained by many doctors elsewhere in the tropics The rationale of the treatment would seem to be that the horse serum furnishes an anti hemolytic substance to the blood of the blackwater fever patients supplying an element which had been rendered ineffec tive because of the disease

These are among the more essentially medical sub jects dealt with at the station In addition to these the following subjects have received attention and some of them reported separately to the Sub Committee for Malarial Research

(1) Malarial survey of Lee County and of districts in neighboring counties

(2) Special anopheline surveys in various regions in Georg a Alabama and Tennessee

(3) Identification of the species of anopheles by the anatomical characters of the larvae reported as a spe cial paper by Dr Paul F Russell.

(4) Feeding habits of anopheles mosquitoes as deter mined by the precipitin test

(5) Limnological studies of the water of anopheles breeding places by Mr Lowell T Coggeshall

(6) Observations on the entrance of anopheles quad rimaculatus into houses by way of chimneys

(7) Observations of the flight and dispersal of anopheles from breeding places

(8) A study of the microsporidia parasitic in mos quitoes by Dr R Kudo

(9) Determination of the infection rate of anopheles quadrimaculatus anopheles crucians and anopheles punctipennis

(10) Prelim nary study of the topographic and geo logic featu es of the limesink region of the Dougherty Pla n in relat on to the en ineering problem of drain a e by Mr F F Longley

The study to define the nature of the malarial prob lem in this reg on involved a variety of subjects deal ing with the hab ts of the anophele mo qu to the dis tribution of anopheles the relation of their breeding places to topography and oil cond tion . As the spec s were found to posses d fferent degrees of susceptibility to infection by malaria a deta led study of the breed ing places of each pecies has been carried out in order that we might learn whether it would be possible to carry out species control or the control of malar a by giving attention especially to the speci s which is the effecti e carrier of malaria So far as our work has progressed it would seem that there is some justification for the statement that species control is po ible and p acticable and that methods for the control of malaria in the Southern States should be deri ed from studies and exper ences in the South and not from the experi ences of others in parts of the world where p obl ms are different in nature from ours. We should aim at an intelligent control based on po itive knowledge d rived wh re er necessary from f eld stud es made in our own communit es Su h intelligent control w ll neces sitate the spec al tra ning of men who are to engage in malaria work and th can best be done in the fi where experience can be obtained by a study of con d tions as they really exist

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ENTOMOLOGICAL RESEARCH IN MALARIA*

By W V King Chairman
U S Bureau of Entomology
Mound La

In preparing this report for the National Committee I have included in addition to a review of the a tivities of the members of the sub committee a brief mention of some of the more important investigations in differ ent parts of the world so as to give something of a picture of the entomological developments during the past year

The subject of the host preferences of anopheles has continued to attract considerable attention but the opinion of American workers seems to be that the pos sibilities of using animals as an effective protection of humans against our species are very doubtful The work of Bull and Reynolds which was discussed at th meet in last year and which has since been published dem onstrated quite clearly that man could not be wholly protected from quadrimaculatus when equally exposed or even when the opportunities for feeding were in favor of the an mals From field ob ervations Barber and Hayne concluded that quadrimaculatus and crucians show no spec al predilection for domestic animals over man when such factors as size and amount of exposure are excluded With certain other species of anopheles however the pro pects for employing animals to divert them are apparently better and I have recently been told by Dr Walch that dome tic buffaloes were used to good advantage in controll ng an epidemic of malaria n the Dutch East Indies

The experiment of Caballero in Spain and others showin that several species of algae of the genus chara were toxic to mosquito larvae have been men tioned in the ess quite frequently and the use of such a plant as a control agent in pools ditches and water containers suggests interesting possibil t es One of the species chara foetida is common in certain parts of the Un ted States but has not been reported as far south as Lou siana I believe In a recent review of the literature on this subject *Dr L O Howard* concludes that this species at least has been quite definitely shown to have a harmful effect on the larvae of certain mosquitoes (aedes and cule) althou h the larvae of anopheles are probably not affected M A Barber found a species (chara robb nsii) growin abun dantly in the r ce fields in southern Louis ana and in testing its act on found that it not only had no nhibit ing effect on anopheles larvae but formed an excellent

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* R p t f m Ch m f S b C mmittee o E t mo l gi l Rese h N t al M l Comm ttee (Co fer M la) meet g j t} w th ther Medical A soc tio E htee th A l Meeti g N w O le L N 4 27 19 4

ranged from palpable to the umbilicus that of the youngest child has always been large ranging from 2 finger breadths to pelvis and that of the boy age 6 was 2 finger breadths before treatment This was reduced to palpable on inspiration during treatment and has remained in that condition since Although the treatment caused all parasites to disappear from the peripheral blood of the girl age 9 it had very little effect on the size of the spleen In every case the size of the spleen has varied somewhat from week to week notable increase in size coming about a week after a notable increase in the number of parasites in the peripheral blood The spleens have always been moderately firm in consistency and never tender excepting for two weeks in the case of the girl age 9

An Experiment With the Standard Quinin Treatment—This was to ascertain the effect of standard quinin treatment in reducing the size of the spleen of children living in a malarial community and it developed out of a suggestion made to us by Dr M A Fort The experiment was conducted by selecting some 75 children in a malarious region in a neighboring county All the children had enlarged spleens and had suffered from malaria the previous summer The children were selected early in the spring and were divided in two groups 50 children were to receive the standard treatment and 25 were to be used as controls The controls had spleens of the same degree of enlargement and were brothers or sisters and lived in the same houses and under the same economic and environmental conditions as the experimental cases The children in both groups have been carefully examined at intervals of about a month since the experiment began Some of the results may be reported now

The standard treatment will remove plasmodium from the peripheral blood for as long a period as it is maintained During this time there is a progressive reduction in the size or mass of the spleen in each type of enlargement It is more marked in the larger sized spleens than in those palpable or palpable on inspiration In the control cases untreated by quinin there was a slight increase in the size of the spleen while at the same time the spleen of those under treatment was steadily reduced in volume The quinin treatment was continued during a period of ten weeks Following its discontinuance there was noted a gradual increase in the spleen mass of all groups of cases

The increase in the spleen rate after the conclusion of treatment appeared not only in the treated group but among the controls as well This was due in part to new infections and undoubtedly in part to relapse because many of the spleens in the treated group had not been reduced by treatments to normal volume and such enlargement as persisted we believe is due in part to latent malarial infection During the course of the experiment observations were made which tended to show that hard work in the fields under the hot sun plowing or harvesting peanuts or other heavy crops provokes relapse in treatment cases even when plasmodia have been driven from the peripheral blood and that this economic factor militates somewhat against success in malarial control by the standard treatment Comparing the results of the experiment with standard quinin and with the quinin administered to the Givens family it is seen that the success is only attained when the quinin is given in proper dosage regularly by responsible persons

Blackwater Fever—Blackwater or hemorrhagic fever has been found to occur in many regions of severe malarial endemicity During 1923 there was an opportunity for observing several cases of this disease in Lee County During the year six deaths occurred Not all of these were seen or investigated but the histories elicited left little doubt as to the correctness of the diagnosis The cases occurred during late summer and fall when malaria throughout the county had reached a high degree of intensity They occurred on farms where anopheles quadrimaculatus was breeding abundantly where spleen rates among the negro children were high and in a number of instances where infected specimens of quadrimaculatus were found in the negro quarters All cases occurred among whites The disease presented no feature different from those seen in other countries

There was however one epidemiological feature which may have some significance In a number of instances houses were pointed out in which two deaths or several cases of blackwater fever had occurred in one family Inquiries elicited the information that sometimes these cases or deaths occurred within a short period of time In other instances a greater period of time had elapsed between the occurrence of the disease in a mother and son or grandparent and grandchild Usually these cases occurred on one farm or in one household so that severity of malaria in the immediate neighborhood might be considered as one of the factors This house or family susceptibility however taken in connection with circumstances just mentioned leads one to suspect that the hemolysis in blackwater fever may be due to an anti hemolytic mechanism rendered defective in certain familial groups of persons by attacks of malaria and that this peculiar defective mechanism is heritable Furthermore on account of the absence of this disease among pure blooded negroes many of whom suffer from malaria to the same extent as the whites who have blackwater fever and in view of the well known fact that races and individuals possess types of blood constitution there is a possibility that only a certain group of persons is susceptible to the disease and that this susceptibility is heritable

Treatment of Blackwater Fever—An important advance in the treatment of this disease would appear to have been made by Dr O L Cranford of Sasser and Dr O W Statham of Leesburg Georgia Dr Cranford first conceived the idea of treating cases of this disease with anti streptococcic serum believing that he was dealing with a disease upon which had been engrafted a streptococcus infection Dr Statham following Dr Crawford's lead has treated some thirty odd cases of the disease with a very low mortality rate His method of procedure is to discontinue quinin and give 20 cc of anti streptococcic serum at once sub

In connection with the above statement I may add that it has now been quite generally accepted by American entomologists that the California species of anopheles which has been known as occidentalis is identical with the common European species anopheles maculipennis Professor Herms mentions the fact that Dr Freeborn had recently reported the o currence of maculipennis in Massachusetts Matheson and Shannon have recorded its occurrence in New York Minnesota and Michigan and these records extend considerably the known range of this species in America

Mr Bruce Mayne who is also a member of this sub committee has prepared the following outline of the studies on which he has been recently engaged together with certain conclusions from his observations

(1) The influence of food and environment on the development of anophelines

I have found that anopheles quadrimaculatus can develop from egg stage to maturity when placed in macroscopically clear water (half tap and half river water) in the absence of vegetation

Recent desiccation stud e have shown that the eggs of anopheles quadrimaculatus and crucians may withstand the action of atmosphere on dried mud—hatching after periods of at least three weeks

(2) Studies of the generations of anopheles crucians and anopheles quadrimaculatus

For this region (Southeastern Georgia) the attempt to determ ne the number of broods per season result d in the convict on that there is a decided overlapping of g nerations

(3) Study of the malaria incidence and mosquito relations in Okefenoke Swamp Georgia

Th s yielded the information that malaria was absent among the swamp inhabitar ts that the only species of anopheles present was crucians that these mosquitoes entered houses and b t freely at all hours

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ENTOMOLOGICAL RESEARCH IN MALARIA*

By S T DARLING M D
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It is a mistake to assume that the habits of anopheles are the same in all regions and that because in India a malaria transmitting species has been found to breed in wells we should assume that the same is true in the Southern States and attempt to control anopheles breeding in wells on the assumption that they are a menace to health A good many of the text books on malaria are comp lations from the world s literature dealing with observations and experiences of workers in India England Italy or Panama where the species of anopheles differ in their habits from those of the Southern States One hears the statement made that borrow pits are breeding places for malarial mosquitoes but we now ha e records of observations made of borrow pits in a number of places in South Georgia Some of them were in the heart of a region of severe malaria but th anopheles breeding in these borrow pits was very scanty The few larvae collected have been crucians with the exception of a few punctipennis in the cooler months and on two occasions a few quadrimaculatus

I do not wish to be understood as saying that borrow p ts are not a menace to health I am merely concerned with their condition at present All borrow pits are not a menace Whether they will become so and breed anopheles quadrimaculatus will depend on their a e and proximity to habitations A study of the l mnology of borrow pits shows that in the younger pits plankton is scanty and sometimes limited to dia t ms and crustacea Under these circumstances the p ts do not support a rich anopheline fauna When borrow p ts grow old and become filled with vegetation then in the neighborhood of habitations when other breeding places customarily used by quadrimaculatus have dried out th species may become implanted Therefore while all borrow pits possess potentialities inimical to the public health in our experience it has not been possible to incriminate them unreservedly as a malarial menace Some discrimination therefore should be exercised in the destruction of borrow pits when there are other real malarial problems in the neighborhood

Illustrative of the tendency to borrow ob ervations and generalizations from abroad and erroneously apply them to our conditions in the South is the well known statement that the malarial mosqu to here can be recog n ed at a glance by its attitude when resting on the wall this mosquito being said to rest with its body projecting outward from the wall at an angle of 45 degrees Culex on the other hand is said to rest with the long axis of its body more nearly parallel with the wall The truth of the matter is that anophele quadrimaculatus the malaria transm tter of the South ern States has a culex l ke attitude and when resting does not usually present the typical anopheline attitude seen in anopheles crucians and punctipennis

We have therefore taken little or nothing for granted but have set out to as ertain if pos ible the nature of the malarial problems in our own locality

Preferential B eeding Places—Our observations tend to show that punctipennis is more apt to be found breed ng in and near running water than in still water On the other hand anopheles crucians and quadrimaculatus seem to require water at rest. This is not only true of the immediate locality but taking the state as a whole the hill stream breeder is punctipennis while quadrimaculatus is found in the flat land or in the hill country where water has come to rest in ponds residual pools swamps or limesinks In th limesink country of Georg a it is not uncommon to find crucians and quadrimaculatus breed ng in the same body of water but there is a large ar a in southeastern Georgia known

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* Report f S b-Committee E t logi l Res b N t l M l Comm ttee (Co f n M lari) meet g joi t) with So th Med l Associ ti Eighteenth A l Meeti g New O l La N 24 27 19 4

medium for rearing the larvae after it had decomposed Aedes aegypti and culex quinquefasciatus also developed in the chara cultures In our work at Mound we have found a species identified as chara haitensis in rice fields and have collected numerous specimens of culex and anopheles larvae in the shallow water directly over the mats of chara growth

Nothing of especial importance in the way of new remedies has been brought out during the year but a few intere ting developments have been noted in the literature Cresol as a larvicide while not new has again been used in at least two instances with good results The Anti malarial Commission in Palestine found it to be a promising larvicide in running water A very weak solution acted as a trap since it did not prevent oviposition but killed the larvae as they hatched They reported that a dilution of one part in 10 million parts of water destroyed the newly hatched larvae and that ■ it was tasteless at this concentration it might possibly be of use in drinking water cisterns Holden in Macedonia used cresol at the rate of one ounce to 100 cubic feet of water (about one part in 100 000) and also found that the advantage over oiling in addi tion to the lower cost was that it did not prevent oviposition in the treated water

The use of gas as a larvicide in such places as wells cisterns etc has been suggested and in a paper by K B Williamson some interesting results with various gases are described He calls attention to the fact that a much lower concentration of a vapor is required to obtain the same toxic effect than with dissolved or floating poisons and that insoluble gases cause no pollution of the water and soluble ones only very slight Chloropicrin proved to be the most effective substance which he tried and when vaporized continu ously in the water container would without further attention prevent mosquito breeding for a long period of time The amount of chloropicrin required to main tain a suficient concentration in still air was very in significant

In the way of biological investigations there are at present several organizations in the Southern states actively engaged on the complex problems of anopheles behavior and a number of instructive papers have been publi hed

My associate Mr Bradley has recently published the results of several years observations on the natural breeding places of anopheles in the vicinity of Mound La In this paper is given a detailed description of the several types of breeding areas and a comparison of the plant growth and general environmental conditions which make a uitable habitat This is a part of a general investigation of the food and other larval requirements In other studies using nets placed over the breeding places he has determined the rate of emergence of adult anopheles per unit of area From this we have been surprised at the extremely small pro duction even where breeding was considered mo t favorable and our general impression gained from such observations is that in the presence of natural enemies and other lim ting factors a very large breeding area i required to produce and maintain a large mosquito population

Barber and Hayne in Arkansas found that the dis appearance of anopheles from the daytime resting place took place within a few days also that the mortality was very high when the mosquitoes were confined in a building corresponding to an occupied screened house These results indicated that poorly screened houses are not apt to serve as a dangerous trap for infected mos quitoes and that infected mosquitoes do not tend ■ remain long about a single house My own observa tions at Mound on the occurrence of infected mos quitoes point to the same conclusion

The subject of attractants and repellants for mosqui toes is an interesting field of study and some new work has been done along this line the most important of which is that of Rudolphs in New Jersey with the salt marsh mos quitoes In testing their reaction toward certain chem ical products of the human body he concluded that per spiration blood urine and sebaceous secretions proved unattractive but that some of the intermediate de composition products (phenylalanin and hemoglobin) were attractive and that several amino acids influenced their activity Carbon dioxid and ammonia ultimate decomposition products were strongly activating and a combination of these with a proper degree of moisture and heat so as to reproduce the conditions of the breath was even more highly so

In the way of repellents you are no doubt familiar with the work of Coogle with creosote oil I under stand that he is to give an account later in this meet ing of the results of his recent control work in Mis sissippi

In re pon e to my request for a summary of the mosquito work in California Profes or Herms as a member of the sub committee has sent the following tatement

Several months ab ence on entomological investiga tions on several of the island of the mid Pacific ocean made it impossible for me to carry on my usual field work in California during the past summer However most of our mosquito work during the past year has been confined to laboratory studies My associate Profe sor S B Freeborn has recently published his work on male terminalia in the *Journal of Hygiene* This study of homologues of the terminalia of male mosquitoes has been accepted by many taxonomists In his recent work in Massachusetts Freeborn has also noted the overlappin of anopheles maculipennis and quadrimaculatus in that state A manuscript on the Mosquitoes of California ■ just about ready for pub lication This will include an ecological and systematic treatment of the th rty pecies found in Cal fornia

The pa t year has been exceedingly dry as have been several previous years with the result that mos quito breeding particularly anopheles has been in gen eral much reduced

Observations have been made regarding w nd blown anophelines In some sections of the southern Sacra mento Valley known to be free of anophelines it has been shown that heavy w nds from the north may bring to these areas anopheles maculipennis from breed ing areas at lea t five m les distant

Among 272 quadrimaculatus [illegible] had fed on man of the remainder 130 had fed on cow 41 on pig 7 on horse 4 on dog and 2 on chicken

All of ten punctipennis tested from which valid data were obtained had fed on animals and none on man

Interesting confirmatory observations were made by trapping mosquitoes that had entered screened houses by coming down the chimneys These traps were placed in the fireplace in such a way that the day s catch could be removed and counted As many as 150 adult anopheles were obtained from one fireplace during two days The mosquitoes were always anopheles quadrimaculatus and were usually unfed virgins

An analysis of catches made from our collecting sta tions in which adult female anopheles are taken from a variety of places indicates that quadrimaculatus is to be found inside and under houses Crucians is found under houses under culverts and in outbuild ings but rarely or never inside habitations Puncti penn s is found in animal sheds outbuildings under bridges and under trees or other sheltered places out of doors Quadrimaculatus therefore apparently di closes a closer relationship with man while crucians and punctipennis are oftener found in more apparent relatio ship with animals Punctipenni while prefer ring animal blood will attack man when he visits the resting pl ces of this spec es in the woods particularly near streams Quadrimaculatus is d stinctly fond of human blood and is commonly found to enter houses at n ght through windows or doors or chimneys

Infect v ty Rate of Wild Mosqu toes—It may be recorded as bear g on the feeding habits of the three species of anopheles and in relation to their efficiency as transmitters of malaria that 2 179 anopheles were dissected in 1923 from May to October inclusive Of th s number 77 punctipennis 571 crucians and 1 471 quadrimaculatus were negative for malarial plasmodia either in stomach or gland wh le 60 specimens of anopheles quadrimaculatus or 3 9 per cent of the num ber of thi species exam ned conta ned malarial plas mod a in either the stomach or glands

Fl ght Exper ments—Flight experiments were made to determ ne the source of the quadrimaculatus visiting a certa n community The fl ght as noted by several observ rs o curred at a certain moment about dusk This was preceded by a movement of bats toward the mosqu to b eeding place Mosquitoes sta ned by a dust ing powder were later collected at several locations ins de and under houses and in outbuildings in the commun ty in question A dusting powder was found to give better results than a liqu d for staining mosqui t es

Dispe sion of Mosqu toes—The dispersion of quad rimaculatus from a large breed ng area into a sparsely populated and scattered community was studied for the purpose of ascerta n ng the approx mate limits within which malarial control would be required Most of the mosquitoes were found within th ee fourths of a mile of the breed ng place very few had traveled as far as one and one half to one and three fourths miles None was found beyond this

Egg Laying Habit—A blood meal appears to be ab solutely necessary for the anopheles mosquito before there can be any development of ova beyond a pri mordial stage After the ingestion of a meal d gestion of the blood proceeds in an orderly manner usually be ing completed in about 48 hours in warm weather or in three or more days in cold weather There i a simultaneous development or maturation of the ovum Observations have been made on these two processes digestive and ovulatory for the purpo e of ascertain ing how long it takes a mosquito to mature her ova after a blood meal and to ascerta n how long she re mains in the place or near the place where the blood meal was obtained also to learn where she rest after that period and for how long a period These ob servations are uncompleted but it may be stated that quadrimaculatus may remain but a day or two within a habitation after obtain ng a blood meal She then leaves the hab tation for another resting place Th s may be near the breeding place or some point inter mediate to it Eggs may not be laid for several days after the blood meal The eggs may be laid at one time or on two successive days Sometimes one or more eggs remain in the oviduct after oviposition Upon d section of such a mosquito later these eggs are an indication that the mosquito has already laid one batch of eggs From these and other stud[illegible] it has been elicited that a mosquito usually completes a feeding upon one person and does not remain in the house for more than a day or two afterwards Two practical points emer e from this first that an infected anophe l ne probably does not feed upon more than one person and does not therefore convey infection to more than one person at the t me of obtaining a blood meal An infected anopheline therefore will not infect a la ge number of persons at one t me as has been su gested Second as anopheles which have entered a house during the night and fed upon the inmates [illegible] move from the buildin after two days or so and their places are taken on successive n ghts by successive lots of anopheles then if it is desired to fumigate houses for the destruction of infected mosquitoes it will be necessary to fumigate every other day or two other wise mosquitoes which had become infected will have left the house without being destroyed House fumiga tion therefore is probably an impracticable measure

Identificat on of the Species of Anopheles by the A atomical Characte of the Larvae—The ability to make immediate dia nosis of the spec es of anopheles larvae enables the mala ologist to incriminate a breed ing place without the d lay usually attendant upon the breeding out of adult from larvae Such information was of value n Panama and in the Orient where all species of anopheles were not efficient transmitters of malaria. If there is as appears to be but one vector of malaria in the Southern States and if that species as she appears to do e ercises preferences in her breeding places then an immed ate diagnosis of the species from

as the Piney Flat Woods in which crucians is almost exclusively to be found. While it is true that the three species are sometimes to be found breeding in the same collections of water very definite tendencies in the selection of breeding places has been noted and this matter is being pursued

Some of the Reaction of Hydrogen ion Concentration of Waters—Not only have the three species been found to disclose preference for the selection of breeding places of certain types but an investigation of the hydrion concentration of these waters has shown that the larger proportion of crucians is taken from waters which are sub acid or minim acid The larger proportion of punctipennis is found not in acid water but in waters which are very slightly alkalin On the other hand most quadrimaculatus are found in waters more nearly neutral than the other two species

Limnological Studies—During the past summer the plankton of breeding water was studied by Mr Lowell T Coggeshall whose studies indicated that punctipennis was oftener found in waters relatively scanty in plankton when compared with waters in which quadrimaculatus was found When the running water of streams was brou ht to rest in residual pools through lack of rain the plankton increased in amount When this occurred quadrimaculatus might then become implanted This last species was found in greater numbers at a period when chlorophyceae were more abundant From those borrow pits limesinks or swamps in which there was little or no anopheles breedin there was a correlated absence of the types of plankton found abundantly where anopheles breeding was present or prolific

Meterological Rainfall and Drought—Interesting records of the density of the three species of anopheles have been made comparing the year 1923 when through the distribution of rainfall there was high ground water with 1924 when during the latter half of the summer drought conditions and low ground water level prevail d throughout the region With the disappearance of quadrimaculatus breeding places in 1924 there was a corresponding diminution in the numbers of anopheles and the amount of malaria and blackwater fever

The relation of air and water temperatures to the density of larvae and adults of the three species has been traced Crucians appears in largest numbers in the spring months of March April May and June rapidly diminishing in July and then more slowly and steadily diminishing in numbers toward the end of the year Punctipennis appears throughout the year adults increasing somewhat in numbers in the cooler months of spring and fall From an epidemiological standpoint quadrimaculatus is the one species the density of which is positively correlated with the prevalence or intensity of malaria

Effect of Cold—Observations on the effect of cold and of freezing temperatures have been interesting and of some practical value perhaps the most important being the effect of cold on the mosquito larvae When the temperature of water is reduced to well below 60 F larvae leave the surface for the bottom of the water rising to the surface when the temperature again becomes elevated During the winter months when temperatures of the water range from 39 to 50 F larvae spend most of their time on the bottom in a quiescent state. If they are disturbed they may return to the surface or nearly to the surface for a few seconds usually dropping to the bottom and remaining there This observation has some practical importance because when searching for breeding places during the cooler months the bottom must be well disturbed so as to bring larvae when present to the surface

Resting Places of Adult Anopheles—The location in which a blooded anopheles is found is only presumptive evidence that she acquired the blood meal in the habitation stable or fowl house in question and occasionally this evidence may be erroneous for dissections of quadrimaculatus caught in a fowl house have revealed mammalian erthyrocytes in the mosquitoes stomachs

In making malarial inspections it is important to know where to look for adult mosquitoes This subject has been thoroughly pursued by searching for every possible type of resting place in the locality inside and under houses behind beds and wardrobes on beams and rafters in outbuildings of different types under culverts bridges tree trunks hollow trees road sides and elsewhere The influence of sunlight and of wind in making mosquitoes seek places of shelter on the windward or leeward side of rafters or chimneys has been noted

Observations on the relative number of males and females caught in various locations in relation to distance from breeding place have been made It appears that during the warmer months the relative number of males to females diminishes directly with the distance from the breeding place and this has been found helpful in the search for anopheles breeding places

In general male mosquitoes are found in greatest numbers close to the breeding place as under bridges (punctipennis) under culverts (crucians) and in tree holes (quadrimaculatus) In these locations 50 per cent and sometimes more of the mosquitoes will be found to be males Mating probably occurs near these locations but may possibly take place farther away for male quadrimaculatus have been found three fourths of a mile from their sole breeding place The great majority of males however was found within less than one fourth of a mile of the breed ng area

Traps—Traps and index boards have been used for the detection of the presence of anopheles near breeding places and for information in regard to feeding habits

Feed ng Habits—The feeding habits of the three species have been investigated by means of the precipitin test with results in keeping with those already ascertained for quadrimaculatus by King and Bull Crucians show very marked tendency to feed on animals rather than man Among 236 crucians 157 fed on cow 33 on pig 30 on horse 11 on dog 2 on chicken and only 3 on man

On the basis of this experience it is estimated that probably not more than one half of the deaths attrib uted to malaria in Alabama should properly be so charged This condition of affairs ■ probably not es entially different in the other Southern States

Class fi t	19 2 N m ber	P C t	19 3 N m be	P C t
C firm d by blood m t	13	6	0	12
Cl ic lly pos t o ly	106	48	69	41
Cl ically d btf l	53	24	47	28
N phy i l	18	8	21	1
E ro eou entry	31	14	12	7
M l ia Deaths—checked	221	70	169	66
M la l D ths—ee d d	304	100	255	100

T ble 1—A ly i f M l D th C rtifi t St t of Alab m b d e l y t t phy ic ■ g g rt fic t

Beside the primary error made by the physician in assigning the cause of death there are also errors in herent in the methods of collecting vital statistics This is best illustrated in the case of South Carolina In many of the coastal counties where the malaria prob lem ■ most evere there is a lack of adequate medical attent on A very large proportion of the deaths which occur are in negroes unattended by a phys cian In these cases instead of being content to enter the death as due to 205 a Cau e ill defined or undetermined the state registrar working under direction of the Census Bureau ■ Wa hington encourages in fact insists upon the local registrars (persons usually with no medical knowledge whatever) entering upon the certificate the probable cause of death That malaria is a very popular and satisfactory term to them is attested to by the results presented in Table 2 While only 11 per cent of the typho d and 17 per cent of the tuberculosis deaths ■ this state are uncertified by physicians 50 per cent of the deaths entered as malaria are diagnosed by the local reg trar

	C f De th	P t f t tal d th tt b t d to thi t ie n t fied by ph Total	Wh t	C l d
1	Typh d d p typh d f	11	6 4	13 7
5	M la	50 1	13 6	5 6
43–49	C	7 5	4 4	1 6
31–37	T berc l	17 1	4 8	20 9
101	Pneum ia	3 5	1 4	41
139	Ch neph t	8 0	4 0	11 6

T bl 2—Comp n f se er l imp rta t ca f d th i g d to th p p rt n of rt fi t t fi d by phys i —S th C roli p i —f M t l ty St t t U S Ce ■ 1 T bl CG pp 100 107

As a result two count■ Beaufort and Berkeley had the highest death rate from malar a of any counties in the Un ted States during 1923 Of the 42 deaths attrib uted to malaria ■ Beaufort County not a single one was certified by a physician Of the 53 deaths in Berk eley only 4 were certified by physicians

That this policy of insisting too strongly on a diag nos s from the local registrar is wrong and inju ious to the state is obvious It vitiates the value of the whole system of statistics coming from this state It would be much better were a greater proportion of the death certificates classified under 205 a Cause ill defined or undetermined than that they should be entered fal laciously as malaria It is teresting to observe in th s connection that in pite of the large rural popula tion in South Carolina with inadequate medical atten tion only 3 per cent of its certificates are classified as cause undetermined whereas in North Carolina 8 per cent and in Mi sis ippi 9 per cent are so classified

Realizing then that the accuracy of malaria death certificates can be considerably improved it is still pos sible ■ obtain valuable reconnaissance information from them The results of two such analyses (2 3) have been publ shed in the Public Health Reports

(*b*) *Morbidity Statistics*—Up to the present little u e has been made of malaria morbidity reports in the Southern States They have been considered of little value because

(1) Physicians ee only a small proportion of malaria cases

(2) Of those seen by physicians only a small pro portion are reported

(3) Of those that are reported in many instances the d agnosis is inaccurate

All of these objections apply if one attempts to use morbidity reports of malaria alone as an index of prev alence

On the other hand it is to be pointed out that malaria morb dity reports can be made a valuable source of information in localizing the malaria problem if they are treated with due regard for the errors involved The report of a case of malaria by a physician should be treated as a notification that the physician thinks malaria is occurring in a certain local ty If this report is repeated and is confirmed by reports of other physi cians of cases in the same locality then the likelihood that a malaria problem exists n this locality is cor respondingly great It is the duty of the local or state health official to e tabli h and extend this knowled e by a field study

This use of malaria not fication naturally requires that each case be reported by name and address It ■ questionable whether reports by phys cians of simply the number of ca es of malaria they have seen during a given period are of any value whatever

(*c*) *Labo atory Exam nat ons for Malaria*—The ex ammat on of blood smears for malaria paras tes for physicians by public health laboratories is the most potent single influence tendin to correct the exag gerated idea of the prevalence of th s disease Not only are many physicians themselves brought to be more careful in their use of the term malaria but through them their patients are being educated The volume of the work in the everal Southern States ■ indicated in the accompanying Table 3 Where 7000 or more ex aminations for malaria parasites are being made each year the effect in more properly restricting the diagnos cannot be questioned

Aside from th s very great service which the public health laboratories are performing the r records are often of considerable value as a source of information regarding prevalence For example the occurrence of an epidemic of malar a may first be ascertained throu h

the larval characters will be a valuable aid to malarial workers

Dr Paul F Russell working in this Station has determined a number of the specific anatomical characters of the larvae of the three species of anopheles and has devised a key which enables us positively to differentiate the species of anopheles of this region from the fourth stage larvae

Key—(1) Abdominal segments 4 and 5 have both a dorsal sub marginal hair and an antepalmate hair—*A crucians*

Abdominal segments 4 and 5 have an antepalmate hair but no dorsal sub marginal hair—2

(2) Anterior internal clypeal hairs close together at base—*A punctipennis*

Anterior internal clypeal hairs well separated at base—*A quadrimaculatus*

MALARIA STATISTICS*

By Kenneth F Maxcy M D
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Your sub committee on statistics accepts the hypothesis that its primary and most important function is to promote a more accurate understanding of the distribution and relative intensity of malaria infection in different parts of the South It is futile to attempt to correlate malaria prevalence with various social economic and geographic factors until the limited localization of the disease is well understood and its prevalence determined with some degree of accuracy Information along these lines is at present meager and crude There is a general tendency grossly to exaggerate the situation with resulting economic injury to certain sections An effort to correct this situation and to present the truth is evidently an important part of any program state or local directed against the disease

The source of all error in this regard is the looseness with which the term "malaria" is used by physicians and by people throughout the South to denote any ill defined feeling of lassitude any minor illness or any fever of undetermined cause Every public health official who is interested in the malaria problem of the South should take careful thought as to ways and means of educating the profession and the public to a more accurate conception of the disease malaria" Too often the tendency is in the opposite direction In order to put over a program the public health official exploits the ignorance of the public to convince them that the disease is a public health problem where it is not In order to satisfy the family of the patient when the diagnosis is unknown the case is labelled malaria

Accurate information regarding the problem will become available only when every Southern state health officer has assigned to one of his assistants the duty of collecting compiling and presenting data regarding malaria prevalence with such uniformity of plan as may render it comparable with similar data from other states This committee should act as a clearing house to promote the use of uniform methods to summarize current knowledge regarding the problem in each state and to make this information available in such form as can be distributed to interested agencies philanthropic educational commercial etc

EPIDEMIOLOGICAL CONCEPTS

In a recent article[1] it has been pointed out that malaria is not generally distributed in any state and indeed in very few counties in the South It exists in limited localities or foci For the sake of uniformity it is suggested that the terms (a) endemic (b) epidemic and (c) potential foci be used as defined in this article to classify and describe the type of prevalence

(1) *Reconnaissance Information*—From the point of view of the public health administrator the available sources of reconnaissance information regarding malaria prevalence in a state or county are chiefly

(a) Mortality Statistics

(b) Morbidity Statistics

(c) Laboratory Examinations

No one source should be depended upon exclusively Evidence from each of the three should be utilized in locating the areas in which the disease customarily prevails

(*a*) *Malaria Mortality Statistics*—The relative inaccuracy of malaria mortality statistics has been sufficiently emphasized On the other hand none will deny the value of this index were it made reasonably accurate Whether desired or not the relative incidence of malaria in the Southern states will probably be measured largely by mortality rates for some time to come Every state health administrator should therefore be vitally interested in seeing that his own state does not receive undeserved and undesirable notoriety in this regard

For example in the State of Alabama during the years 1922 1923 an attempt was made to ascertain the size of the error by sending a special inquiry to every physician signing a certificate of death as due to malaria The results of this inquiry are presented in Table 1

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*Report of Sub-Committee on Statistics National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La Nov 24 7 1924

malaria and assist the various state registrars to secure more accurate registration

(g) That the necessity for taking definite measures to combat professional and popular misconception of the diagnosis "malaria" be brought to the attention of all state health officers concerned and the importance of this phase of the campaign against malaria be emphasized

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ENGINEERING IN MALARIA*

By J A LePrince
Senior Sanitary Engineer U S P H S
Memphis Tenn

Your Committee took up with the State Sanitary Engineers and State Health Departments the question of improper road culvert installation improper location and grading of borrow pits and of insanitary roadside ditches A copy of the letter sent to 45 states is attached to this report Our letter which requested replies to nine questions has resulted in considerable increased activity in the way of mosquito elimination by drainage along highways in a number of states and many county highway engineers have written to the state health officials thanking them for bringing this matter up and also offering their hearty support The state sanitary engineers have in many instances taken this matter up with the county highway commissioners who in turn are showing interest and doing more and better drainage Some of the state highway engineers have issued instructions to their assistant engineers to pay special attention to drainage from the standpoint of eradication of the mosquito

Our plan is to get a large number of county engineers interested in mosquito control drainage

An attempt was made to get some of the chief engineers and general managers of the railroads traversing the malaria belt to attend the Conference of the Malaria Field Workers at New Orleans on November 25 and 26 but the program was too crowded to devote the time to prevention of malaria by railroads that the subject deserves

An article has been prepared and accepted for publication in one of our Government road engineering magazines that has a large circulation among engineers and contractors and others interested or engaged in highway construction

Another paper entitled What the Engineer Can and Should Do for Mosquito Control and Malaria Control is being published in two technical journals and an abstract of it entitled Responsibility of Engineers and Contractors for Malaria and Mosquito Nuisances will appear at an early date in The American City Magazine

DISCUSSION ON RELATIVE IMPORTANCE IN TRANSMITTING MALARIA OF ANOPHELES QUADRIMACULATUS PUNCTIPENNIS AND CRUCIANS AND ADVISABILITY OF DIFFERENTIATING BETWEEN *THESE SPECIES IN APPLYING* CONTROL MEASURES*

By S T Darling M D
International Health Board
Leesburg Ga

When I came South early in 1923 to study malaria I noticed that there was a tendency among the malarial workers with whom I conversed to speak of anopheles mosquitoes and anopheles breeding places without regard to species

In literature on malaria in the South references were made to anopheles breeding places instead of specifying that they were the breeding places of quadrimaculatus punctipennis or crucians It was also explicitly stated that all three species had been proven to be transmitters of malaria (Sweet) although the opinion was encountered in conversation as well as in the literature (Komp) that of the three species quadrimaculatus was the most effective carrier

The opinion held as to the relative importance of the three species in malaria transmission is based on the incriminating experiments of King and Mayne by the results of the dissections of wild mosquitoes by King Mayne and Metz and on the epidemiological observations of Carter and Fisher

King and Mayne determined that each one of the three species could be infected experimentally

The evidence which we possess that quadrimaculatus can be naturally infected is derived from the work of King Mayne and Metz

There is only one recorded instance in the literature of the finding of a naturally infected specimen of punctipennis This was found by Mayne in September 1916 from Talladega Springs Ala

With regard to crucians Mayne (Mitzmain) found in the malarial village of Lenwill northern Louisiana one

* Report of Sub-Committee on Engineering [illegible] Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La Nov 24 27 1924

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RESULTS OF DISSECTIONS IN 1923

	A p nct p s		A eruc a s		A qu drima ulatus		
	N D s	No P	No D s	No. Pos	No D s	[illegible] P	T tals
M y	5	0	43	0	2	0	51
J ne	19	0	45	[illegible]	7	0	91
July	8	0	45	0	118	3	171
A gust	2	0	219	0	391	20	632
Sept mb	13	[illegible]	125	0	302	10	440
O t ber	9	0	30	0	61	13	300
T tals	6	0	507	0	110	46	1686
D Root d ect n	1	[illegible]	64	[illegible]	4 9	14	494
G nd T tals	7	0	571	0	1531	60	21 9

P nt g f 1531 A q d macul tus d sected—p s t 3 9 p c t
[illegible] re ntag of 571 A n d ect d—pos ti 0 0 per nt.
P ntage [illegible] 7 A pu ct p n s d sect d—po t 0 0 p r e nt

pecimen of crucians out of twenty examined to have sporozoites in the salivary gland At the same time (August 23 November 25 1917) 2 4 per cent of 709 quadrimaculatus were also found to be infected naturally Metz examined 3 9 pecimens of crucians from the neighborhood of Lakeland Fla Two or 0 5 per cent were found infected At the same time 423 pecimens of anopheles quadrimaculatus caught in the same neighborhood yielded an infection rate of 0 9 per cent

Epidemiological testimony for the incrimination of crucians was submitted by Beyer and his colleagues but this was not regarded as good evidence by King (I have not yet consulted the papers in question) The epidemiological evidence in the case of anopheles quadrimaculatus as being an effective carrier in the transmission of malaria is complete and sound and tallies with the evidence derived from the dissection of mosquitoes

Malaria according to Dr Henry R Carter has never been found prevalent where anopheles punctipennis alone has been found breeding

Fisher believes that punctipennis may have been responsible for malaria at Chester S C 1919 because the topography is typically the kind in which punctipennis occurs and that was the only pecies found and was producing freely close to houses In these observations of Fisher s it is stated that the topography of the country near Chester with its streams deeply eroding the red clay of the Piedmont Plateau is typical of the kind in which punctipennis occurs but while he is careful to note that no ponds occur in the section except about four miles east of the town he states that during low water stages the stream beds contain eroded depressions in which water is retained forming favorable mosquito breeding places

Now our observations go to show that when regular visits at hort intervals and collections are made in such residual pools as form in these eroded depressions quadrimaculatus will occasionally be found for thi species tends to become implanted in the still water of the pools disappearing when the water current [illegible] the stream is restored Sometimes the two species coexist for a short time in these residual pools but it has taken careful weekly inspections of such streams and pools to gather this important piece of information It is possible therefore that there may have been some quadrimaculatus breeding in the re idual pools at Chester

Beside the view that all three pecies of anopheles are to be regarded as transmitters of malaria there was an opinion held naturally enough under the circumstances that all anopheles breeding places were equally a menace from a public health standpoint and that all required attention in order to control malaria

We know quite well from the investigations made in other countries that all anopheles of a region are not equally hospitable to experimental infection and all are not found equally infected in nature

In Panama when anopheles malefactor was fed in jars with anopheles albimanus on patients from which 70 per cent of the albimanus became infected anopheles malefactor failed to become infected under the circumstances This mosquito which failed in its susceptibility to malarial infection was found also to have breeding habits different from anopheles albimanus the malaria carrier for malefactor was a sylvan species Another species encountered in Panama was anopheles pseudopunctipennis Only 4 out of 31 mosquitoes (13 per cent) under the most favorable experimental conditions became infected and this mosquito relatively inhospitable to malaria infection also possessed habits different from tho e of the malaria carrier for punctipenni was rarely or never taken in quarters and its breeding places were often encountered two miles or more beyond human habitations

From the dissection of anopheles mosquitoes and observation of their habits I have learned that sometimes anopheles which are reputed to be efficient transmitters of malaria feed on animals as well as on man The evidence therefore required to incriminate a species as being an effective transmitter of malaria should include the natural infectivity rate of wild specimens of this species collected in regions of severe malaria where the species normally breed and naturally by preference feed on man or animals Should the evidence fail to incriminate the species then testimony should be elicited dealing with the habits of the species tending to show why it did not become infected evidence for example that it preferred the blood of animals to that of man

In determining the relative importance of the different species of anopheles as vectors of malaria it is essential that a number of human malarial carriers be present at a time when the mosquitoes are breeding in order that an infectivity rate may be determined without the dissection of an inordinate number of specimens that is to say the information should be

forthcoming from the dissection of 500 specimens or less In selecting Lee County Georgia as a place to establish a station for the study of malaria a district was found where the malaria was severe and where three species of anopheles were to be found during the seasons

The Infectivity Rate of the Three Species in Lee County Georgia—The mosquitoes dissected in this series were collected from a wide variety of situations and all of them in the neighborhood of habitations where spleen rates ranged from 8 to 100 per cent Most of them were taken at a time when spleen rates were 40 per cent or over and also where spleen rates of from 30 to 50 per cent were to be found during the winter and spring of 1923 1924 Spleen rates are always 50 to 75 per cent higher than blood rates No matter what the season whether winter or early fall gamete carriers were always available for the infection of anopheles species seeking a blood meal from man In many instances when the mosquitoes were collected for dissection the spleen and blood rates of the children were obtained at the same time In this way some definite information was obtained for the correlation of mosquito infectivity rates with the spleen and parasite rates and an attempt was made to avoid the source of error likely to occur when mosquito vectors are searched for in a region where the malarial rate of each mosquito collecting place is not known

A number of the specimens of crucians dissected 166 in all were taken under or inside houses or in other locations in which quadrimaculatus some of them infected were taken at the same time

Discussion of the Results of the Dissections—The infection rates of quadrimaculatus taken from different locations range from 2 to 5 per cent during the warm months of the year The rate for the entire summer from May to October inclusive was 3 9 per cent During the same period not a single crucians was found to be infected although they were usually taken under houses where infected quadrimaculatus were found at some time during the summer This negative evidence against crucians is all the stronger because the species was usually found along with quadrimaculatus

It is regrettable that the negative evidence against punctipennis is still incomplete This is partly due to the circumstance that adult punctipennis are not very abundant during the malarial season and are not found in locations so close to man as is the case with quadrimaculatus and crucians This species is found in large numbers in the streams of the Piedmont Plateau and elsewhere but curiously enough malaria is less common or absent in these localities Punctipennis was rarely taken inside and under houses where quadrimaculatus and crucians were constantly found They were found rather in outbuildings roadsides under bridges and in woods near the streams in which they bred and in places where presumptively they had acquired a blood meal from animals rather than from man

The information which we elicited positively incriminates quadrimaculatus as being a carrier of malaria and the sole carrier of malaria in the region under consideration

With regard to crucians and punctipennis not a single specimen as yet has been found infected The evidence with regard to crucians while of a negative character is conclusive enough for practical purposes More work will need to be done with anopheles punctipennis

Preferential Feeding Habits of Anopheles Crucians Punctipennis and Quadrimaculatus—Noting that the two first mentioned species were rarely found feeding on man and never to the extent observed with anopheles quadrimaculatus the proved effective transmitter of malaria it was desired to ascertain the origin of the blood meal in specimens of these two species by the precipitin test The tests were carried out by Dr Bull in his laboratory in Baltimore and the very marked preference for animal blood of anopheles crucians and punctipennis was disclosed

Our data in regard to this question is being added to particularly with reference to anopheles punctipennis It is noteworthy that of 9 blooded specimens of punctipennis tested by King and Bull none had fed on man but all were found to react to the anti serum of the horse cow pig or dog

The precipitin test revealing as it does the preference of crucians and punctipennis for animal blood to that of man shows us why these two species although susceptible to infection experimentally do not become so naturally and why they should probably not be regarded as efficient carriers of malaria

The Correlation Between Malaria Prevalence and the Seasonal Density of the Three Species of Anopheles—When the incidence of malaria as determined by spleen blood rate or by histories is compared with the density of the three species of mosquitoes at several periods of the year it is seen that when quadrimaculatus is found in greater numbers the malaria correspondingly increases while at the same time crucians and punctipennis diminish in numbers for quadrimaculatus is a mosquito preferring warm weather while crucians and punctipennis are found in greatest numbers in the cooler months when the incidence and severity of malaria are at their lowest points

Other Epidemiological Testimony—A comparison of the geographical distribution of malaria with the distribution of anopheles mosquitoes in places which I have studied discloses the fact that malaria is found where quadrimaculatus and quadrimaculatus breeding places are abundant and that malaria is sparse or absent where this mosquito and its breeding places are infrequent or absent

In the regions of the South where hill streams are exclusively the type of water collections found and where streams are not impounded and where there is no standing water in limesinks there is little or no malaria In these places where water is in motion punctipennis is the prevailing species When however the water in the streams is brought to rest as in the residual pools which are formed in the bed of the river during late summer or by the impounding of a stream

ORIGIN OF BLOOD MEAL OF ANOPHELES MOSQUITOES DETERMINED BY THE PRECIPITIN TEST

	Man	Horse	Cow	Pig	Dog	Chicken	Total
Quadrimaculatus	89	7	130	41	4	2	272
Crucians	3	30	157	33	11	2	236
Punctipennis	0	0	8	1	1	0	10
Total	91	37	295	5	[illegible]	4	518

quadrimaculatus may become implanted and malaria break out

In the regions where malaria is prevalent and at the time when it is prevalent neither crucians nor punctipennis is the species exclusively to be found

There are large areas in southeastern Georgia where anopheles crucians is almost exclusively to be found and in these regions malaria is infrequent or entirely absent

A striking bit of testimony may be presented tending to show that malaria is more prevalent in places where there is still water favorable for the breeding of anopheles quadrimaculatus than in places where there is running water in which punctipennis abounds or again in the wet piney flat woods of southeastern Georgia where crucians is almost exclusively to be found

The state of Georgia may be divided with reference to certain topographical and geological formations into about seven regions Each region has a characteristic surface formation and each region yields a characteristic history in regard to the severity of the malaria encountered therein

Regions 1 and 3 the Cumberland Plateau and Appalachian Mountains are mountains with falls and rapidly running streams in which type of water punctipennis breeds but in which quadrimaculatus is not usually encountered No fatal cases of malaria are reported from these regions

Region 2 is the Appalachian Valley In these valleys although punctipennis is the predominant species anopheles quadrimaculatus must find a few acceptable breeding places in the flat lands for a few deaths from malaria are reported annually

Region 4 is the Piedmont Plateau a rolling country throughout with characteristic red clay eroded by the streams Punctipennis is the predominant species excepting in places and at times when water has been brought to rest and becomes favorable for the breeding of quadrimaculatus There is some scattered malaria in this region

Region 6 the piney flat woods region is relatively free from severe malaria Here so far as our investigations have gone punctipennis is absent crucians is the predominating species but quadrimaculatus occurs in places

No 5 A and B and 7 represent a peculiar limestone formation in which the limesinks occur in large numbers These sinks are formed by the corrosion of the subterranean limestone strata The falling in of the superincumbent layers of soil has formed basins and bowl like depressions often containing standing water in which quadrimaculatus will breed if habitations are within reach These are preeminently the malaria regions of Georgia and although punctipennis and crucians are found breeding in various waters quadrimaculatus is found in these regions in much larger numbers than in any other area of Georgia so far as our investigation has disclosed

Conclusions so far from my own investigations are that quadrimaculatus is probably the only effective transmitter of malaria This is because of the high rate of natural infectibility and its demonstrated fondness for the blood of man Crucians and punctipennis for practical purposes are not to be regarded as vectors of the disease because of the absence of naturally infected specimens in regions of very severe endemicity where nearly 4 per cent of quadrimaculatus were found to be infected and because of their demonstrated almost exclusive fondness for the blood of animals and not of man

With regard to the work of others it can be said that up to the present only one naturally infected specimen of punctipennis and three naturally infected specimens of crucians have been recorded This circumstance in connection with the very small though definite number of specimens of crucians and punctipennis found by the precipitin test to have fed on the blood of man leads me to believe that the chances of malaria s being naturally transmitted by these species while physically possible are too remote for consideration by the practical sanitarian

The Advisability of Differentiating Between These Species in Applying Control Measures—Species control or species sanitation is a practical measure and is being used in other countries In the South we must first ascertain whether the three species exercise any preference in selecting breeding places At our Station we have observed certain tendencies in this regard For example quadrimaculatus is found exclusively in still water The same is true of crucians Punctipennis on the other hand is found in or near running water or in still water near by although this species has been found in many types of still water The point is that quadrimaculatus the effective malaria carrier will not breed while the current of water is maintained Before a stream is impounded this species is either absent extremely sparse or not found until drought in late summer has caused pools to form in the bed of streams After the current is reestablished in this stream quadrimaculatus tends to disappear Probably there is not an absolute disappearance but one equivalent to a reduction to a number at which malaria does not occur This is analogous to the relation between the stegomyia index or numbers of these mosquitoes below which yellow fever cannot be transmitted

The physical state or condition of the water which renders it more suitable as a breeding place for quadri

maculatus may be related to abundance of food for it differs with these changes in physical state and in plankton food while the water is in motion and at a time when punctipennis will breed and an increase in the amount of plankton upon stagnation at a time when quadrimaculatus becomes implanted

The biochemistry of the different breeding places varies with these changes in physical state and in plankton and this is indicated in the tendencies of different bodies of water from which we have taken the three species to have a different reaction when measured by a determination of the hydrogen ion concentration of the water That is to say in swamps ditches borrow pits and other bodies of water from which crucians has been taken the average p_H will be sub acid or minim acid Punctipennis taken from stagnant stream margins puddles pool and limesinks is usually found in water which is neutral sub alkaline or minim alkal is wh le quadrimaculatus found in wooded ponds pools limesinks and swamps ranges between the other two species and its curve of p_H frequency denotes tendenc es different from those of the other two species The curves of frequency depend partly on the frequency of occurrence of certain types of water from which our larval collections were made Still when we study the types of water collections frequented by the three species for breeding we come upon definite tendencies and never find punctipenni for example breeding in swamps with acid water althou h crucians and quadrimaculatus may abound therein On the other hand cruc ans and quadrimaculatus are not to be found in ru n n water or in well

Considering certain other collections of water irre spective of their physical or biochemical state we have noted tendencies for the occurrence of certain pecies due to as yet unascertained causes

Few or no anopheles we e found in a number of borrow pits regula ly examined throu hout the year When larvae were present cruc ans wa the species encountered Quadrimaculatus larvae were very rarely taken from borrow p ts unless the p ts were ol l w th a rich growth of vegetation and near habitations Even then they appeared in very small numbers and for a very short period of time when breed ng of quadrimaculatus was very scanty in leed due to drying up of their customary breed ng places None of these borrow pits s in any sense a menace to health While it is true that borrow pits may become a nu sance or menace to health in the economical admin stration of malaria control work some di crim nation at first must be exercised in the r elim nation

Wells—In India wells become breed g places for malaria anophelines The same is probably not true n the Southern States Plankton is very scanty in well water and in our e perience anophel s breed ng likewise is scanty The anophel s spec es usually encountered in wells is punctipennis Ra ly in an abandoned well crucians has been fou d but quadrimaculatus has only been taken once and th was in a partly filled well without a curb a d in a ne ghborhood where all the qu drimaculatus breed ng plac s had dried up and in this instance larvae were detected only on one occasion

Other collections of water which have been under repeated examinations for periods upward of two years have failed to disclose breeding of quadrimaculatus A number of ditches near habitations have bred crucians durin the greater part of the year and in winter have yielded punct pennis occasionally but they ha e always been free from quadrimaculatus Other ditches near habitations breeding crucians or punctipennis rarely have bred quadrimaculatus except when the customary places for quadrimaculatus had dried out Here may be noted a tendency for quadrimaculatus to refrain from breeding in certain d tches excepting during periods of drought Their numbers are then always small and may remain below a number calculated to support malaria in the locality

Swamps and Ponds—These when situated more than a mile or two from habitations have usually been found to breed crucians only When habitations are within fl ht distance quadrimaculatus may become implanted The need therefore for controlling crucians breeding in such locations is not imperative and these places should wait until the more urgent problem dealing with quadrimaculatus has been ascertained and solved

Econom c Reasons for Differentiating Species—Dr Carter has already said that to pend a dollar on sanitation and get less than 100 cents benefit is not only bad business but bad sanitation We all kno that malarial control operat ons are expensive Expensive also is the maintenance which must be provided for The money to pay for these operations must come out of the pockets of the local tax payers A prudent and humane expenditure of funds requires that the worst places the real sources of infection should be considered first To do this the specific nature of the problem should first be d termined instead of attempting to use general measures wh ch may have been based on experiences derived from other regions havin their own special kind of anopheles and hab ts

In makin these observations it should be stated that the studies are still being pursued and are as yet incomplete Certa n tendencies in the breed ng preference of anopheles undoubtedly have been revealed and the e tendencies must be studied for a sufficiently lon time before general ation can be made and explicit direc t ons gi en to health officers and sanitary inspectors

If it emerges I think it will that the a ophel have e efe ential bre l ng pl es n l that we can in a g d many in tance pec fically carry out pecie control then th m thod ot identif cat on f pe s b the r larval characters d eloped in our laboratory at Lee burg by Dr Paul F Russell will be a valuable a d to malariolo i ts and an tarians

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DISCUSSION (Abstract)

Dr M A Barber U S P H S Greenwood Miss—We have made a four years study of the habits of anopheline larvae in the Southern United States and the longer we study the less disposed we are to generalize As regards the preference of the different species for certain breeding places we arrived at some rough generalizations which have been getting rougher every year In the spring we have found abundant anopheles punctipennis in ponds and in small pools in or near woods Such punctipennis containing pools are quite independent of streams and are common in the southern parts of Georgia Alabama and Louisiana

We have long been making observations regarding the relation of anopheles breeding to the hydrogen ion concentration of waters and we have found all three of the common species of anophel s highly adaptable to natural waters of greatly varying hydrogen ion concentration In aquaria where widely varying hydrogen ion concentrations were constantly maintained anopheles quadrimaculatus and crucians seemed to develop from egg to imago at practically the same rapidity

As regards the part played by the different species of anopheles in the transmission of malaria ne ative epidemiological evidence is not convincing We find a low malaria rate in parts of the rice growing regions of Arkansas and Louisiana in which anopheles quadrimaculatus a known carrier is very abundant

Likewise the absence of naturally infected anopheles crucians is evidence of weight only in a very long series of dissections One may get long negative series in dissections of anopheles quadrimaculatus In feeding anopheles on malaria carriers we have found crucians highly susceptible to infection In one experiment where crucians and quadrimaculatus were fed at the same time on the same patient practically identical percentages of infection were obtained and sporozoites formed in the gut in both species on the same day after biting

As regards the biting habits of anopheles crucians Mr Hayne and I can testify from personal experience for in some experiments with man baited mosquito traps we served as the baits Anopheles crucians bred in salt marshes are eager biters of man even in the daytime

In sum we do not believe that anopheles crucians at least can be exonerated as a carrier of malaria

Dr W V King U S Bureau of Entomology Mound La—At Mound we have a great predominance of one species quadrimaculatus while our yearly collections show only 2 to 3 per cent of punctipennis and crucians The fact that they are present but only in relatively small numbers although the breeding areas are extensive and well suited to the production of quadrimaculatus is a striking example of the difference between the three species in their breeding requirements

Punctipennis is strictly a spring species with us and crucians is found in the spring and early summer Like Dr Barber I do not care to generalize on the kind of breedin places selected by the different species except that the larvae of punctipennis are sometimes found alone in certain temporary pools and in the shallower borrow pits along the Missi sippi River where no vegetation is growing

We have made a very large number of examinations of adult anopheles for malaria infections but unfortunately the small proportion of punctipennis and crucians which were examined did not give a great deal of information on these two species Probably several hundred of each have been dissected without finding parasites but these negative results are of little significance since the infection rate judging from quadrimaculatus is normally very low

I should like to ask Dr Darling what percentage of the mosquitoes examined at Leesville were found with the sporozoite stage of the parasite?

Mr J A LePrince U S P H S Memphis Tenn—Dr Darling wisely stated that it is very necessary to study each locality We find that local changes in sub surface strata as well as local changes of topography are often responsible for producing intermittent or permanent breeding places of anopheles quadrimaculatus in territory that might appear to be favorable to anopheles punctipennis only Such conditions may produce malaria foci in what we might term territory apparently suitable for punctipennis only In this connection seepage outcrops may become of decided sanitary importance

Many surveys have been made which indicate that we can have a community heavily infested with punctipennis some malaria carriers present and very little transmission of malaria In several instances malaria control campaigns have been conducted in which sources of anopheles punctipennis were ignored but the public demands mosquito freedom as well as malaria freedom and health workers find it advisable to comply with what the public insists upon having

Regarding roadside borrow pits in some localities they are prolific sources of anopheles while in other cases they may not be of importance Future study will probably show us the reasons why this is true

In small spring water suppl es I find larvae of punctipennis and an absence of the larvae of other anopheles

Perhaps ten years from today our public will allow us to plan campaigns against the local malaria carrying mosquito and to ignore other mosquito breeding places They are more interested today in reduction of the *mosquito nuisance*

Mr L M Fisher U S P H S Columbia S C—This year at Chester we have found some crucians but no quadrimaculatus There were some collectors of quiet water in wh ch quadrimaculatus could be produced particularly in quarry pits The edges of the water con

tained a great deal of vegetation but we found only punctipennis

Dr King brought out the point that it takes a large number of mosquitoes to keep malaria alive It takes a large area to produce a large quantity of mosquitoes The natural breeding places for quadrimaculatus in the vicinity of Chester and in the country near there is such that we do not have extensive areas and it is difficult at least for me to see how we could get *the malaria we have there from the small number of* breeding places there

I also want to emphasize the point Mr LePrince made that we must control all the mosquitoes if we want to get the tax payers money and it makes it very difficult to do selective control work of the different species

Dr L D Fr cks U S Public Health Serv ce Mem phis Te n—I wish to add a few words on the subject of bor ow pits in relation to mosquito production Borrow pit is rather a loose term Borrow pits vary greatly in character even in the same locality and those of one region may be and frequently are entirely dis s milar to those of another in regard to mosquito production

Dr King made the statement that in northeast Louisiana there is an appreciable amount of mosquito breeding in borrow pits particularly of punctipennis in ear y spring

It has been reported to me since 1919 by service officers working in south Georgia that the borrow pits found there very rarely produce anophel ne mosquitoes during the summer months Borrow pits are of common occurrence along the recently constructed high ways in south Georgia Usually they are comparatively shallow with clean banks little vegetation and generally without shade of any kind Under these conditions one *would not expect to find and we have not found* Anopheles mosquitoes producing to any extent

In regard to the malaria situation at Chester South Carolina wh h was reported by Mr Fisher I may say that this has been a subject of con iderable intere t to those of us who were acquainted with it Several years ago Mr Fisher reported a sharp outbreak of malaria in Chester and after a careful survey and tudy during wh ch he was unable to find any Anopheles quadrimaculatus he was incl ed to attribute this outbreak *to* Anopheles punctipenn s Mr Fisher has repeated his mosquito surveys in Chester several times since the or ginal outbreak and has never found Anopheles quad r maculatus I understand he is of the op nion that Anophel s punctip nnis was responsible for the malaria in Chester South Carolina I believe that we are generally agreed that while su h a condition is possible it is decidedly exceptional

Dr C A Kane Virginia State Health Department R chmond Va—In Williamsburg Virginia where only punctipennis breeding was found and with some malaria the health officer was satisfied that the malaria was being carr ed by punctipennis In July last a survey was made in detail covering every part of the community and to our surprise two permanent ponds were found back of the State Asylum that were breeding quadrimaculatus They had evidently bred quadrimaculatus in previous years These ponds have been drained and the territory will be tudied during the coming year

Mr A F Allen Assistant San t y Eng neer U ted States Public Health Se vice El Paso Tex—I am in the lower Rio Grande section of Texa where the conditions are different from those in the rest of the southern United States The hot season is longer and the seasons are inverted due to the irrigation When it is the dry rainless season we have it wet and the wet or rainy season is drier from a mosquito production point of view than the dry season

About two weeks ago I collected a pint of water from a borrow p t along a canal It had between two and three hundred Anopheles larvae at the time it was taken and they were all taken within twenty feet along the borrow pit We hatched out five d fferent kinds of Anopheles from that one pint of water The predominating one was psuedo punctipennis The next was probably punctipennis the next quadrimaculatus and the next albimanus which so far as we know exists nowhere else in the United States except in that thousand square miles of territory down there and lastly crucians

We are still wondering which is or are causing the malaria down there Any one of the five is in sufficient numbers to create the malaria wh ch is present We ar not trying to do much with it because we are on yellow fever control but we are trying to find what is causing some 5 or 6 per cent of the people down there to have malaria each year

When five kinds of Anopheles come out of the same *borrow pit it is an unusual cond tion* I doubt that hydrogen ion concentration can have much to do with the suitability of this borrow pit water for the various species

Dr Darl ng (clos g)—Dr Ki g asked the percentage of sporozoa carriers in the larvae I have not the figures but it was something under one per cent

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PROGRAM FOR COUNTY WIDE MALARIA CONTROL*

By S W Welch M D
State Health Officer
Montgomery Ala

I am a pract cal every day workin man and in a gathering of scientists I have considerable difficulty in knowing what I think about thing After a discussion like th s I am still more at a loss to know what I think But I am very proud of the accomplishments in Alabama resulting from the team work of my scientific and practical associates

The question of malaria control on a county wide bas s had its origin in Alabama One of my assistants worked out a plan and subm tted it for approval After a discussion by the whole group a plan was agreed upon and the first demonstrati n was made in 1921 or 1922

Since that time we have worked out a still better plan which seems to me to be growing more practical every day but at the same time is changing e ery day The g eat trouble in the publ health game is that the

*Re d bef the N t nal Mala Comm ttee (Co f nc M lari) meet g co joi tly with So th Med cal Associat E htee th A l Meet g New O leans La. N 24 27 1924

things we do one year we can t do the next year At the same time we have made some progress

The malaria program should always be a part of the general program of public health work It is a mistake for any health unit or any health organization to special ize on any one particular thing to the neglect of all the other public health activities and public health inter ests which come up for consideration

In putting over a malaria program on a county wide basis we must have a perfectly definite plan worked out for malaria control that dovetails into all the other activities

The county health officer should locate his ma laria problem He can do that very easily by a school census and by statistical reports that come in Nine times out of ten he will find that probably he has *not one malaria focus in his county or certainly not* more than two or three

I was under the impression when we started that malar a was widespread over every county in Alabama The scientists demonstrated clearly to my mind that it was a local proposition

In my home county which is about sixty five miles long and thirty miles wide we have one malaria focus and that is along a stream about ten miles long on which is an impounded water At one time I made my living on malaria infected people There is no malaria there now

You must make a special study of the problems of each county locate the malaria ascertain the size of the project and then decide which of the many methods of control you are going to use before you start in If you don t you will waste much time and more money

A malaria program should never be financed out of the appropriation for a health unit It is an extra piece of work and does not affect the whole population in the county or even the whole population of a com munity It is local and should be suppl ed either by a pecial *appropriation by the county or by a special* appropriation added to by those who are immediately benefited the drainage district area for instance

We have recently passed a constitutional amendment in Alabama which permits the establishment of drain age areas We expect by recla ming waste land and bringing into cultivation rich land along the border to get further cred t for having controll d malaria

The only project which we have undertaken which is distinctive from our general work this year has been the one of the City of Selma There the county put up *$5 000 the c ty put up $5 000 The state directed* the work through the machinery of the local unit and the ucce s of the project sati fied all of our expecta tions

There are several method of control which have been gone over o often as probably to be out of place at this particular time but I want to insist upon this one point that you mu t find out where your problem i what it i the method wh ch you will use whether it is drainage or whatever it is select the method of control that prom es to be most effective in that par ticular local ty and eliminate from your mind the idea that malaria is disseminated all over the territory which you wish to control

Go after the most heavily infected places first be cause those are the foci from which malaria is scattered over the entire state

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DISCUSSION (Abstract)

Dr W G Smillie I H B Andalusia Ala—Rural malaria control can best be undertaken in an area where there is a well established county health unit having a carefully balanced program Sporadic ef fort that may be undertaken to control malaria by the state health department or other agencies will be of some avail but the work is not continuous and there fore is not productive of permanent results

Dr Welch has already indicated what the county health officer can and cannot do The fir t duty is to determine the prevalence of and the location of the foci of malaria in his county This may require one or two seasons

The county health officer should then choose one or at most two foci a year and study them thoroughly The county health officer having studied the chosen malaria focus well and having determined where the Anopeles quadrimaculatus breeding is occurring which is causing malaria should then call in an expert ma lariologist to help decide the best methods of control. He will be wise if he refrains from making any suggestion as to control measures before receiving ex pert advice

If we are to have successful rural malaria control in the South each state health department must have an expert malariologist on the staff He can best be a member of the department of epidemiology An ideal arrangement would be to have a state epidemiologist who is an expert in malaria control He should be available to go to the various counties after the health officer has studied a given malaria focus and determine for the county health officer the best method of con trol for the given project If drainage is the best *method to be employed then the state department of* sanitary engineering can be called into consultation in regard to methods to be followed If some other method of control is more feasible the state malariologist will outline the plan of control and advise the health of ficer and the other persons of the county that are most concerned as to the best methods of procedure

Dr W S Rankin Health Off cer Raleigh N C—I wish to know whether Dr Welch has had any ex perience in the method of control de cribed in a county located in a tidal ect on a county in wh ch the water in the rivers and streams ri es and falls to an ap preciable extent with the tides

Dr H A Taylor Rale gh N C—We always attempt to organize a county health department fir t Many of our fa lures have been due to the fact that we have left no one behind actually to carry on or continue the control method after we withdraw

In dealing with malaria in the t de water section we have no special foci of infection The infection ranges from 10 to 16 per cent in the and hills and from 50 to 60 per cent in the bottom or low lands We cann t apply anti larval mea ures in our section

We fi d that a major ty of the lands are owned by a

few resident owners Their homes as a rule are well constructed and located favorably with reference to the breeding of mosquitoes while the homes of tenants are loosely constructed will not lend themselves to screening and are very favorably located for the breeding of mosquitoes It is here that the health officer experiences a most difficult problem in malaria control He has approximately 75 to 80 per cent of the population with no means of control at his command except quininization

Now unfortunately in the tide water section we have not the preferential breeding places that you have in the hill section A few years ago we began with a county wide propaganda and after making a complete survey we found punctipennis and crucians breeding in certain isolated places We thought at that time quadrimaculatus would select certain places in which to deposit eggs but as the summer months approached we found that all three were breeding in places alike Therefore we cannot differentiate between the breeding habits of the three species in eastern North Carolina It is here that we call in every known method of control at our command using the health department as a nucleus We dovetail our work with the general routine duties of the health officer and make this a distinct part of his work in an attempt to get him to devote 75 per cent of his time to malaria control work We have been fairly successful

Mr Frank R Shaw U S P H S New Orleans La—St Mary Parish Louisiana where I worked this season is only one hundred miles west of New Orlean and is bordered immediately by the Gulf About forty per cent of the parish area is subject to slight inundation due to tidal fluctuation of the Gulf These tidal changes and conditions of inundation may be wholly different from those of rivers but the method of drainage control might be equally applicable

At the town of Patterson the officials were desirous of malaria mosquito control but a preliminary survey revealed a stagnant tidal swamp entirely across the edge of the town and extending to a sluggish bayou and thence to the Gulf The conditions looked prohibitive but engineering levels from the bayou to the edge of town and periodic reading of a gauge in the bayou showed that although average daily high tide was three tenths of a foot higher than the average ground at the edge of town there occurred an outfall every 12 hours amounting to from 1/ to 3 feet

By constructing a canal in the swamp parallel to the edge of town and through an existing railroad culvert and then to the bayou the building of a 1/ foot levee along the tide side of the canal from high land to the railroad embankment and the placing of Calco Automatic Tide Gate culverts we established a barrier to high tides and yet availed ourselves of the tide fluctuations through the automatic operation of the gates

The gates are to be found on the market and for all practical purposes are very efficient but it seems that little knowledge exists as to their purpose and practical application to many conditions otherwise unapproachable They are being used to some little extent in Louisiana

The ditching in this project involved 7 00 feet of 0 foot canal and 3500 feet of 5 foot laterals all of which was constructed with dynamite

Mr J A LePrince U S P H S Memphis Tenn—Where the rise and fall of tidal water is much less than it is in North Carolina anopheles production is more difficult to control But even under such conditions we do not face an impossible problem and as Dr Welch stated success depends upon the selection of the correct method of procedure

Even when drainage and use of larvicides are not practical there remain other control methods that can be used

With properly developed public cooperation we can control malaria Lack of funds and drainage difficulties may make the problem more difficult but do not make control impossible

Dr T H D Griffitts U S P H S Montgomery Ala—If you have an organization to do anti typhoid work or hookworm work or any other kind of public health work you will have an organization that in a short time can be made to do malaria control The whole thing hinges on getting county health organizations together In the malaria counties select the county health officer who is already a malaria man or one who will become sufficiently interested in the control of malaria to make a head of a proper organization in that county

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TRAINING FACILITIES FOR MALARIA PERSONNEL*

By L D Fricks M D
Surgeon U S P H S
Memphis Tenn

Before we begin to discuss training facilities for malaria personnel let us determine whether we are in general agreement concerning certain major propositions which must be included in or excluded from the discussion if we are to make any headway in the limited time at our disposal Let us assume that the malaria personnel referred to in this discussion are to be used in the control of malaria in the United States—either as assistants to or as a part of the properly constituted health forces May I also assume that we are agreed on the proposition that malaria in the United States is a rural health problem and as such should be handled by a full time county health organization along with other health problems And further that none of us would be willing to advocate the training of malaria personnel to take the place of the county health unit and devote its entire time to malaria control, as has been done in tropical countries

If these propositions are granted then we come at once to such pertinent questions as these What personnel is most badly needed by the state and county health departments of the South in the control of malaria? What facilities do we have for training this personnel? How can these facilities be used to best advantage? *How can they be expanded in accordance with our needs?*

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*Re d bef N t o l M la Comm ttee (Co f M l) meetl g) tly w th S th Med cal Assoc. i E hteen th A l M t g N w O le La., N 24 27 1924

It inevitably follows that as the fight against malaria in the United States changes from one phase to another as it has changed in the past and no doubt will change in the future the type of trained personnel most badly needed will alter At the present time it seems to me each state health department of the South should have the following trained personnel A sanitary engineer who knows the principles and practical application of drainage methods in mosquito control an epidemiologist who can be relied upon to determine what are the more important factors which enter into the spread of malaria in a given locality a vital statistician who can stimulate the reporting of malaria cases evaluate and gradually correct malaria records sent in to his division a laboratory director who is competent to diagnose malaria from thick and thin blood smears and anxious to extend this service throughout the state

For the county health unit we would suggest that the county health officer himself should be trained in the principles of malaria transmission and malaria control so that he can drive home the facts intelligently to the people and develop a strong desire in them to rid themselves of the malaria burden No great progress can be made in the control of malaria as it must be controlled in the United States until the people themselves earnestly desire it and are willing to pay for it The county health officer should know how to define his malaria problem and determine what trained assistance he may need from the state health department or other cooperative agency in handling this problem The county health unit should contain a sanitary inspector who has practical knowledge of malaria transmission and malaria control In those counties which have a malaria problem the inspector should give the greater part of his time during the summer months to malaria control during the winter months he may well be employed in other rural health matters It is my judgment that at the present time the training and the duties of the sanitary inspector are more important than those of any other member of the malaria personnel The sanitary inspector with proper training enthusiasm and an unhampered field of action can perhaps do more than anyone else toward the control of malaria in the United States under the program which we are working and should work In addition to the sanitary inspector the county nurse should also be informed of the principles of malaria transmission and control She can accomplish much good in personal talks while visiting homes and schools in the county

Now what facilities have we for training all or any of this malaria personnel? Something has been done in this direction in the past few years perhaps much more than can be done in the future To my knowledge five agencies have contributed toward the training of malaria personnel in the United States possibly there are others which I do not recall at this moment The Sub Committee on Medical Research and the Sub Committee on Engineering of the National Malaria Committee have been very active in getting malaria and malaria control taught in the medical and engineering schools of the United States The Bureau of Entomology has given instruction along entomological lines to a number of malaria workers at its field station Mound Louisiana Probably the Public Health Service has trained a greater number of malaria workers and along more lines than any other agency Hardly anyone who has to do with malaria control in the United States at the present time has not gained something from Dr H R Carter or Mr J A LePrince and service officers trained by them have carried their instruction to local health officers throughout the South The World War offered the Public Health Service an unusual opportunity for training a large number of medical officers sanitary engineers and laboratory technicians in malaria and malaria control methods The International Health Board has contributed greatly to the training of malaria workers by sending them to the field where they could observe practical demonstrations of different methods employed in malaria control Recently the International Health Board has established a training school for malaria workers at Leesburg Georgia It should not be forgotten that the State Health Departments of many Southern States have added their bit By establishing divisions for malaria control they have encouraged their personnel to study malaria and develop themselves generally in the practical school of experience into trained malaria workers

We must confess however that there has been no coordinated effort undertaken in the United States for the adequate training of malaria personnel along all lines The establishment of a training school of this character has been discussed by public health officers for several years but the service has never been in a position to finance such a school to bring pupils to it It is to be hoped that the International Health Board which has a greater freedom in the expenditure of its funds will be able to continue and expand the training school for malaria workers which has been established at Leesburg Georgia The one suggestion however which we would make relative to the training of malaria personnel for practical purposes is that the greatest good can be accomplished at the present time by making this instruction practical and directing it particularly to the sanitary inspector

DISCUSSION (Abstract)

Dr S T Darling Leesburg Ga—Dr Fricks has admirably expressed the need and requirements for training and training facilities in malaria I want simply to emphasize what he has said I felt that in our work at Leesburg the investigator s de was not the most important one but that equally important was the opportunity we had there for giving instructions some of it very elementary in malariology

First we have given instruction to some of the medical officers of the International Health Board but little by little we have added to that Health officers epidemiologists and one or two sanitary inspectors and even technicians have been sent to us and we can give them instruction in the various phases of malariology chiefly so far as regards making the survey making the inspection

At present we haven't undertaken any control work but we hope that in the near future we shall be able to undertake something of that sort

I have been very much impressed with the lack of thorough knowledge that I have encountered among some of the men who have been sent to me I can see the great need for instruction in some of the simple and elementary things in relation to malaria

Dr K F Maxcy U S P H S Montgomery Ala—It is hardly feasible to assemble health officers inspectors and nurses at any one point for instruction Funds are lacking Instruction must be given in the field where malaria work is being done This means that in each state provision should be made for a man attached to the State department of health who is competent to instruct the personnel of the various county health units in malaria work In this way perhaps we can accomplish our end more quickly than if we tried to organize the teaching on a more concentrated basis

Dr C A Kane State Board of Health Richmond Va—We have found it necessary to give special training in malaria control to our county health officers in eastern Virginia In 1923 eight counties were selected and malarial mosquito study stations located in each county to be studied by the health officer throughout the year This consisted of weekly collections of larvae hatching and identifying of mosquitoes and weekly collections of the adult mosquitoes from houses stables and other feeding places and identifying these mosquitoes and making a record of them The health officers were assisted in this work by Dr L L Williams Jr and myself until they were thoroughly familiar with the routine study which is used by Dr Darling in Leesburg In the past we have had health officers from Hopkins and one from Harvard Although they had theoretical knowledge of mosquitoes and knew that it was necessary to drain use oil and give quinin they were unfamiliar with field work and were not thoroughly familiar with the habits of anopheline mosquitoes We find it necessary to give special instruction to each health officer that we employ in Virginia regardless of his experience in the past

Dr W G Smillie I H B Andalusia Ala—In rural control our line of first defense must be the county health officer and his assistants Our object at the Training Station in Andalusia therefore has been to give newly appointed county health officers a brief field training in malaria control Men have come to us during 1924 from Oklahoma Tennessee Alabama South Carolina Arkansas, Texas and Georgia When a new county health officer is appointed a small fund is appropriated for two to three months training in county health work Those men that will have a malaria problem in their county are first assigned to Dr Darling's malaria research laboratory in Leesburg Georgia to learn the fundamentals of anopheline entomology and the general principles of a malaria survey After one month men are then assigned to a county in which there is malaria and as a part of their general county health program they take an actual part in the activities of the health unit under the supervision of the director of the training station If the novice in training remains for a third month he is assigned to a definite malaria focus which is studied by him in detail such as making suitable sketch maps house to house visits, anopheles surveys etc

With this short preliminary training the newly appointed county health officer goes to his assignment with at least a general idea as to the methods of approach to his malaria problem and if he should be so fortunate as to be employed in a state which has a state malariologist he should be able to conduct rural malaria control satisfactorily

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METHODS OF MALARIA CONTROL TO BE ADVOCATED WHERE ANTI LARVAL MEASURES ARE IMPRACTICABLE*

By W S Rankin M D
State Health Officer
Raleigh N C

The subject implies that there are places where anti larval measures will not control malaria I did not suggest or select that subject It is in line however with very high authority as to the practicability of malaria control in certain places

There is a little town in eastern North Carolina with about two thousand people where Dr Henry R Carter once went to make a survey When he had gone over the town he met the people to discuss what measures they could take against malaria They said

What can we do Doctor?

The only thing you can do to get rid of malaria in N he said is to move to Y

With the advances that have been made since that time some twelve or fifteen years ago none of us here now would say that malaria could not be controlled within reasonable expenditures in any locality Not in a county There is a difference between a town and a county but in a particular town or locality

I asked the question this morning if anyone knew of a tidal country where malaria had been controlled on a county wide basis and one gentleman replied that he was working in such a county and cited the control of malaria mind you in a locality three miles square!

The methods of control that have been worked out here and in Alabama and that have been emphasized by Dr Welch and Dr Smillie and Dr Maxcy are thoroughly sound and I am fully sold to the idea that malaria can be controlled when it exists in a community or in a circumscribed locality The question that I have to discuss is What are you going to do with malaria when it is not circumscribed but county wide and in a county where drainage measures are so expensive as to be practically out of the question

Now what do I mean by such a county? There are counties in eastern North Carolina where from 30 to 50 or 60 per cent of the people have malaria There are areas in those counties of from 200 to 300 square miles

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*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with the Southern Medical Association Eighteenth Annual Meeting New Orleans La., November 24 7 1924

heavily infected with malaria I am *not* talking about a locality 2 miles one way and 6 or 8 miles the other way I am talking about a big piece of country where from 30 to 40 per cent of the people have malaria in a tidal section and not in a Piedmont section

The old health officers here my friends Welch Ferrell Fricks and others know and will bear me witness that when this malaria work was started on a state basis several years ago I took the position that the problem was still one largely of research and that there were so many things to be found out about it that there was a question in my mind as to whether the states and counties with their limited machinery and limited resources should attack it until the research worker had gone further

I was persuaded however by these two gentlemen and by the example of my other friends in the South to go into it so we started malaria control in the tidal section of eastern North Carolina

The International Health Board agreed to put up $2 000 per year per county The State Board of Health agreed to put up $4 000 more and asked the county for $4 000 making $10 000 appropriation The idea was to feature malaria as the major local health problem The other things were minor The further idea and plan was to work two years in a county making a $20 000 *piece of work*

We shall have finished the work on the first of January in four counties and shall have finished the first year s work in three other counties and three more counties now want to start in making ten counties in all

My idea when I went in when I was sold (and I am not so sold now as I used to be) was that we would work about twenty of twenty five countie in eastern North Carolina

Here recently my friend who did so much to encourage me to get into this game has raised the qu stion as to the practicability of the measures in these counties where drainage we think is out of the que tion

I have seen Savannah and Jacksonville doing anti *malaria work of a very high order* I know that malaria can be controlled there I am talking of a rural section a tidal area where nobody that I know who has gone into it would dare to propose draina e

The only thing that we have been doing and the only thing that we know now to do is to use quinin We have gone into the schools we have gone into the homes with nur es have taken the blood gotten the history and *told* them *all* about how to use quinin What have we accomplished?

The original survey showed that about 50 per cent of the people in this rural section had malaria A survey of 1 400 people in the same area conducted this year showed that there had been about a 30 per cent decrease

Unquestionably a lot of good has been done There is definite progress *The first year the statistics showed* 50 per cent of infection That may have been higher than the average year or lower than the average year and the next year s rate may have been higher or lower However such figures as we have questionable in their evidence perhaps show that there has been about a 30 per cent reduction

The question is whether the same amount of money spent on some other health problem would not have accomplished a larger reduction in morbidity and mortality

Mr LePrince said there was another way than the quinin method by which we could attack malaria But how long will these indifferent anemic people keep houses screened? It isn t so much screening the house as it is getting the health sense into the malaria infested population that counts

The State of North Carolina isn t going to continue this piece of work which it was encouraged to assume if the United States Public Service and the International Health Board that urged us to get into it raise a question as to the practical value of it

DISCUSSION (Abstract)

Dr John A Ferrell I H B New York N Y—The type of county in which Dr Rankin in North Carolina is attempting to combat malaria is found on or near the sea coast from Mexico to Maryland Malaria in this vast area is an outstanding problem The country is flat sparsely settled The streams are deep tortuous and sluggish and generally are influenced by tides and floods Economic resources as a rule are quite limited

North Carolina and other coastal states because of malaria are confronted with a difficult problem but we do not expect that the authorities of North Carolina or any other state will accept the obstacles as unsurmountable and consider for a moment having the people abandon these extensive areas in favor of the anopheles mosquitoes

The attempts to conquer malaria in these sections will be continued Infancy and maternity and other health problems should be given consideration by the health organizations in logical sequence but should not be concentrated on in the very malarious communities until malaria has been reduced to a degree which at least *renders them safely habitable*

Let us all stand by our guns and continue the fight bringing to our support any scientific investigators who may perhaps simplify a ta k wh ch to some has seemed almost insuperable The reduction in the incidences and severity of the disease as reported by Dr Rankin and Dr Taylor for some of their counties by the methods they employed is most encouraging

The cost of more permanent measures of control that may be feasible if too great to be borne locally might be assumed in part at least by the state Personally I believe it is only a matter of time with the consequent growth in population and wealth before the fertile coastal plains of the South will completely banish malaria and afford healthful and inviting fields for agricultural and other pursu ts and that the result will be achieved by the state and county jointly working together

Mr J A LePrince U S P H S Mempl s Tenn—Every openin leading into a house is a potential route of travel for mosqu toes In 191 G ffitts showed that

anopheles quadrimaculatus came down chimneys into the rooms of two-story farm houses in South Carolina Where large openings have been trapped we have thus caught from a few to hundreds of anopheles per trap per night

We are not doing enough toward destroying infected anopheles and are doing very little yet toward making them destroy themselves Both of these control methods can probably be further developed but even in their present status can be made of large practical value

One of the reasons why more progress is not made in malaria elimination is that frequently those directing the field work are in doubt as to possible results obtainable and consequently are insufficiently interested We can reduce malaria even where drainage and use of larvacides are not practical at the present time

Dr I J Kligler I H B Palestine—In one malaria unit in Palestine we tried screening in another quinin The screening was not very successful because owing to the heat the people refused to keep the screens closed House to house distribution of quinin reduced the amount of black water fever as was shown by the microscopic examinations that were made after the mosquito season had closed The following year a different method of supplying quinin was tried with much better success Instead of distributing quinin from house to house it was given to the children while at school Other members of the community who had active symptoms were of course treated with quinin At the end of the season the results showed that no black water fever had occurred and that the number of relapses was lower than the year before As the method of giving quinin to school children is much less expensive than attempting to distribute the drug to each individual member of the community we are continuing the school work Malaria has not been eliminated but it has been brought under control at a very low cost

Dr H H Howard I H B Laurel Miss—In British Guiana one of the European colonies in South America I suppose they have one of the most difficult problems known with regard to sanitary drainage soil pollution and malaria control The densely populated sections are below high tide level and are protected by sea dykes and tide gates It is no infrequent thing to see ten inches of rain water over the lands standing until low tide when it can drain into the sea and drainage at best is very imperfect Malaria was a scourge to the people Anti larval measures did not suffice Systematic quinin medication and prophylaxis oiling better drainage some screening use of bars have done wonders to relieve the working population who suffered most

Often the seemingly impossible can be accomplished if we but try and persist in our efforts

I remember some years ago that the statement was not infrequently made that it was impossible to have the rural populations in the Southern States put in and use sanitary privies I have lived to see that disproved Many of the people are building and using them

I am not much in sympathy with the statement that screening is necessarily a failure as a means of protection from the mosquito It possibly is never 100 per cent efficient but whites are living in many places today in the Mississippi Delta in safety behind screens often improperly looked after where before screening was known or practiced it would have been impossible

I am not in sympathy with the statement that quininization is not worth while in sections where mosquito control is impossible

There are large sections in the world where the systematic use of quinin has emptied the hospitals and put a malaria stricken labor population on its feet and back at work in the fields This occurred in the British Colony to which I have previously referred Quinin was administered to the entire laboring population in certain sections in appropriate dosage three times a week with the previously mentioned results and the saving of hundreds of dollars in hospital upkeep and labor loss from sickness

Returning to screening we all admit that successful screening and its maintenance are difficult but where there is no easy way to control malaria the more difficult measures of control should not be abandoned because they are difficult and do not always produce perfect results

Until we begin to advocate screening there will not be much screening done We know a house can be screened effectively and that with the cooperation of an educated public effective screening can be maintained indefinitely Screening should be a very helpful measure for malaria control in the section referred to by Dr Rankin

Why we have in a large measure in late years ceased to emphasize screening as a measure for malaria control I do not know Is it because it is difficult and requires considerable educational work to secure effective cooperation from the people? Experts like Mr LePrince and others of experience still believe in screening I am sure We should revive our interest and the interest of people in malarious regions in effective screening and in the proper use of quinin

I feel that whatever structure we have been able to build in public health work today and we have reason to be proud of our accomplishments has been built entirely upon the results of careful painstaking research work of scientists

We have interpreted their finding translating them into field activities and control measures and as administrators this is our part The scientist's interpretation of his findings often does not stand the field test practical application which is the ultimate test of theory but the work of the scientist in his proper field has formed the background for all of our public health work today and it is proper that credit should be given him

I feel since my own work for a number of years has consisted in a large measure in translating the findings of the scientific laboratory into active field measures that we are greatly indebted to these men who have been paticularly and peculiarly equipped for investigation and that we should continue to base our field work on the results of their investigations

Dr M A Barber U S P H S Greenwood Miss—In parts of the irrigated rice growing regions of Arkansas and Louisiana anopheles quadrimaculatus is exceedingly abundant yet the malaria rate is very low A relatively high general standard of living conditions may be an important factor in keeping down the malaria rate At all events it is evident that a low malaria rate is possible in the presence of large numbers of anopheles quadrimaculatus

I can confirm from personal observation the statement of Mr LePrince that the screening of the houses

of negro tenants is a practical possibility. On a certain cotton plantation in Arkansas fully half of the tenant houses are screened, and Dr Henry Thiebault, who has had many years of practice among negro plantation workers, told me that the negroes appreciate their screens and take care of them.

Dr S T Darling, Leesburg, Ga.—It would be interesting to have Dr Barber tell us something about the economic status of the people in the rice fields, whether they are well paid, well fed, etc.

Dr T H D Griffitts, U S P H S, Montgomery, Ala.—I did not understand Dr Rankin, Prince of Optimism, as to what methods they have applied that resulted in such discouragement on his part. I should like to know.

Dr F J Underwood, Jackson, Miss.—Dr Rankin obtained within a short period of twenty four months a 30 per cent reduction according to statistics. I believe that the withdrawal of the support of the International Health Board is the only discouraging feature of the work to him. I see no reason why he can not work the problem out with the liberal appropriation made by the State Board of Health and with the proper local financial backing which should be easily obtainable after his most splendid demonstration.

It is only over a period of years that we can get results in this work. With the educational work already done generations yet unborn will profit by this program. I do not think that Dr Rankin should feel discouraged at all.

Dr Rankin (closing).—It really makes me feel good to hear people talk about my being discouraged. Usually I *am put down on the other side. If a few of my* friends who talk about my conservatism and caution get me in John Ferrell's conservative class I shall think that I am about right.

I am not discouraged. I started out talking about what a sane and practical plan was available for the whole Piedmont section of the South. I stated that *there had been so far as the tangible evidence is concerned* a 30 per cent reduction in the short two years in which we worked in eastern North Carolina. Why should I be discouraged?

Dr Fricks and Dr Ferrell said to me, "Come down into the swamps of eastern North Carolina and let's play a cooperative game." I went with them.

Now that they have me down there they want to leave me there. That is the whole proposition.

Dr Ferrell says, "Where is the evidence?"

Dr Ferrell perhaps has people back of him who are asking for a sign, who are not so full of faith. They want figures. You can not get figures with a problem of that sort unless you spend considerable money doing all your first survey over.

Now that will be fine work provided the International Health Board pays for the second survey.

I will stay down there in the swamp as long as Dr Ferrell wants to stay there, but the State Board of Health does not want him to get us started on something, then raise the question as to its practicability and value, and leave us holding the bag in *the swamp like* the freshman on his first snipe hunt.

FEASIBILITY OF ADVOCATING BUILDING DESIGNS OR REGULATIONS IN REFERENCE TO MOSQUITO CONTROL*

By J A LEPRINCE
Senior Sanitary Engineer U S P H S
Memphis Tenn

We can assume the existence of a country with sanitary regulations *so perfect, specific and so broad* that if they were definitely applied sanitary conditions would be all that could be desired and the system of procedure a model for us all to follow.

To what extent does the improving or increasing of sanitary regulations increase the amount of practical applied sanitation accomplished, and can we accomplish more applied rural sanitation with or without regulations, whether enforced or otherwise. The writer is inclined to believe it is far more important to create increased public interest in sanitation, one subject at a time, than to confuse the public with a number of subjects and regulations that they do not understand, do not want, and sometimes indicate they do not propose to have. The public is compelled by law to pay the bills for public sanitation and as they are buying health or welfare they are entitled to state what they desire to purchase. It is only fair to let them see and understand what is in the enclosed and wrapped package they are persuaded to purchase.

The objective of regulations such as are indicated in the title of this paper would be to get new rural homes so planned and so constructed that without seriously decreasing any advantages of the homes as they are built today, and with very little additional cost, the new homes could be made and kept effectively screened at minimum expense.

Can this objective be accomplished better by means other than sanitary regulations, state, county or local?

The speaker is of the opinion that properly applied publicity and interestingly presented information that is not very dead will go a long way toward making the property owners want to construct screenable homes.

A practical demonstration is the best means of publicity. The big problem is to get a sufficient number of property owners fully to realize that by malaria elimination the productive value and income from farm lands in malarious regions can be increased. We must not expect rapid progress along these lines. If we can get the new homes that are to be built so planned as to be kept anopheles proof at a *minimum* expense we shall accomplish much.

The answer to the problem is a question. It is what is the best, cheapest and quickest way to get property owners and tenants to want very much to live in homes

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*Read before National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association, *Eighteenth Annual Meeting*, New Orleans, La., Nov 24-27, 1924.

that can be both screened and kept so at minimum expense

DISCUSSION (Abstract)

Dr T H D Griffitts U S P H S Montgomery Ala—The question of screening in counties where there is a health organization has been too much neglected As health officers make their rounds of the county why can t they make an effort to have every new house that is built in the county though the construction is already started so constructed that it may be economically screened?

I also wonder if it is not possible to extend the principle of getting a permit for building houses not so rigidly as it is in the cities but as is necessary in the country so that houses may not be located in notoriously malarious localities when they can as easily be located elsewhere It seems to me that the county health officer in any state can at least know a part of the houses that are being built at any particular time and see the owner and talk to him of the importance of screening against mosquitoes flies and other insects We can appeal to him from the standpoint of comfort as well as general and specific health

I do not think anything along this line is being done

If I were a county health officer today I would see every owner who is constructing a house in the county and get him to understand that an unscreened house in a community where typhoid may prevail or where malaria exists is not a home

Dr J L Bowman Montgomery Ala—Where we have land owners who are interested enough and willing to build such houses as could be screened we have no malaria In other sections the land owners although their tenants are dying of black water fever or are ill with malaria keep them in houses where no screen doors or screen windows could be fitted and if it were possible to fit them there would still be abundant openings in the houses for mosquitoes to enter That is the section of the country where we have the malaria The land owners tell you either that they have no malaria in their community or that they do not care if they have If the tenants become sick they will get others

Mr LePrince (closing)—I could talk on this subject for three hours but what I would have to say can be boiled down to four words—IT CAN BE DONE!

MALARIA ACTIVITIES*

By John A Ferrell, M D
International Health Board
New York, N Y

The International Health Board s malaria program in the United States on which Dr Fricks asked me to report is generally known by those present

As indicated by Dr Fricks financial assistance was given during 1920 1921 and 1922 toward the co operative measures for the control of malaria in towns That feature of the work has been discontinued as far as practicable except in towns included as a part of programs of county wide malaria control by county health organizations

The program for a county as a whole is exceedingly difficult because the anopheles breeding areas are extensive and financial resources limited To succeed there must be a minimum of lost motion Competent investigators such as are now representing the Federal Government and also our own organization in this field should be given every facility needed with the expectation that more efficient economical and direct methods of dealing with the rural problem may be found

The International Health Board is committed to aiding investigative work of this character and to aiding official health agencies in their own development to the end that they may assume full responsibility for dealing with the malaria problem and also the other important health problems that may be encountered Aid is given for a temporary period while the work is in a demonstration stage. Our participation in meeting the cost of the work should be as brief as possible and the official agencies should adequately occupy the field without private assistance as quickly as possible

Every state board of health having an extensive malarious area should be able to assign a medical epidemiologist having special training in malaria a malariologist to study the situation in each county or community and recommend the most economical and effective control methods He should be able also to instruct and assist the personnel of the county health organizations Moreover it is important for such states to supply also the services of a sanitary engineer skilled in malaria control who can supervise or cooperate in measures involving drainage improved housing conditions screening and in engineering projects prevent "man made" malaria

During the present year our Board has aided 13 state boards of health toward employing malaria personnel such as I have just referred to and it has aided 13 states toward establishing 27 county organizations each of which for a period of from one to three years is committed to centering attention on malaria control. Moreover it is gratifying to note that several other county organizations many of which have been organized for several years, are now engaged actively and more or less independently in combating malaria.

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* Report from Members of Sub-Committee on Administration, National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Eighteenth Annual Meeting, New Orleans, La., Nov. 24-27, 1924

MALARIA CONTROL ACTIVITIES IN ALABAMA*

By S W WELCH M D
State Health Officer,
Montgomery Ala

THE ADOPTION OF ANTIMALARIA MEASURES BY COMMUNITIES

A full report of the antimalaria activities of the Alabama State Board of Health in 1924 will be available in February or March of 1925 The purpose of the sub committee will perhaps be best served by a concise statement of the administrative features of the work under *the headings assigned to it by the National* Malaria Committee

Only one community in Alabama adopted anti malaria measures in cooperation with the State Board of Health in 1924 This was the City of Selma in Dallas County which entered into an agreement with the state through the County Health organization after a study had been made of the malaria situation at the request of the local officials By the terms of this agreement the City Council and Board of County Commissioners appropriated jointly the sum of $10 000 for a malaria and mosquito control campaign to be directed by an engineer from the State Board of Health whose services were without cost to the city and county The attention of one regular city inspector was assigned to the campaign

Work was begun in May 1924 It consisted of drainage projects for a series of ponds some of which were within the city limits others immediately outside the city but within flight range of certain sections filling of certain areas by diversion of city waste to this purpose malaria investigations of the residents of infectible areas education of citizens by means of moving picture shows and newspaper articles in methods of malaria control by screening and standard treatment use of oil or paris green on suitable areas house to house inspection for the control of the pest mosquito

In August a report filed by Mr C C Kiker Assistant Sanitary Engineer gave the following figures to show how the $10 000 appropriation had been spent up to that date

P h se d op t f t k	$ 630 7
Tool l mbe d eq pm t	471 10
P p	1 164 99
Labo	3 561 7
F m n	448 55
I pect	3 44
O l d d t b tio	478 87
I d t l	38 85
T t l	$7 427 9

R p t f m M mbe f S b C mmittee Adm t tl N t l M la Comm tt (Co f M l) meet g tly w th S th M d l A oc t F ghtee th A n l Meet g N w O l L N 24 27 19 4

This amount may be divided and charged [illegible] the two general classes of work as follows

M l a C t l (d n g)	[illegible] 950 62
P t fer M squ to Cont ol	1 476 67
T t l	$7 427 29

In October the following was reported

All of the ponds formerly existing in the City of Selma and its immediate environ have been drained

The work that has been done in and around Selma has been a cleancut 99 per cent job The engineering has been of the highest order the local cooperation excellent There are funds left over from the estimate on the original plans which should be applied to correction of places in the county

The fact that only one city government as such adopted anti malaria measures in 1924 is accounted for by the administrative policy of the State Board of Health which adheres strongly to the plan of conducting malaria control work through the county health units wherever a local organization exists

For this purpose three sanitary engineers from the State Board of Health are available at the request of county health officers for preliminary investigation work and for makin surveys and establishing grades for drainage projects The health officers are then advised as to the best methods of malaria and mosquito control and the various projects throughout the county are conducted under the direction of the county health officers

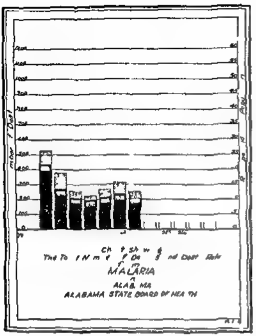
Twenty three counties comprising 38 4 per cent of the total area of the state and supporting 36 per cent of the total population have been thus assisted in handling their malaria problems during 1924

The outstanding points studied and activities conducted by counties are reported to the State Board of Health by the County Health Officers under the following headings

Lin Feet f N w Dit hi g
Li f t D t h M t
B eed g A C ted by D t h g
(A)
App m t Sq Feet O l d (P l G)
B d g A [illegible] t d by O l g or P l G n
(A)
App x mat C t f W k I d ted Ab
P p l t L g i Infect bl T lt ry
App m t p t g H m a th A l S m
M S d
Sq m l M l a T t ry
N mb r kn w E d m Mal Foci
Plac tock d w th G mb ia
N mbe f N w p p A t l o M l i
N mber P ec M l a Lit t D t ib t d
N mbe f P p l T ght M l a (I add ti n to South
n S ppl m t)
N mb M l a Le t (f these w l [illegible] l)
N mb Att d g M l i Lect
N mb Fi ld D m t tio
N mbe Att d F ld D m t tl
N mbe M la a E h b t
N mb r Att d g M l i F h bit
N mb f t m M l F lm Show
N mb P pl Sh wn T
Rem k (N te yth g f i terest)

MALARIA SURVEYS AND DEMONSTRATION OF ANTI MALARIA WORK IN SUITABLE COMMUNITIES

In add tion to the surveys made and ty wide demonstrations of *antimalaria work* zed



counties malaria investigations were made in and around mill plants in counties not organized for full time health service This work was undertaken by a man detailed to the State Board of Health by the United States Public Health Service

The communities in non health unit counties as well as in the organized counties which have been selected for special study and demonstration are those adjacent to impounded waters

The magnitude of this work can best be illustrated by stating the amount of money that has been and is being spent in Alabama for construction of hydro electric plants figures given in round numbers for construction work at Muscle Shoals by the United States Government are one hundred million dollars Mitchell Dam Alabama Power Company eight million dollars Cherokee Bluff Alabama Power Company ten million dollars Barlett Ferry Columbus Electric Company seven million dollars Gantt Projects One and Two River Falls Power Company five hundred fifty thousand dollars City of Dothan Power Company one million dollars There are several small projects which have been given attention The results obtained in thes studies have been very interesting The marked increase in the production of quadrimaculatus during the breeding season on these ponds is one most worthy of note

Our first step in control consists in a request by the power company for a permit to impound the water the second a survey of the basin the third issuing a preliminary permit the fourth a malaria survey of the inhabitants living within flight range of the pond the fifth the basin is required to be cleared of all timber and other floatage and vegetation These regulations apply to small ponds as well as to large impounded waters Latitude in the enforcement of the regulations is permitted to the Board When the conditions specified in the preliminary permit have been complied with the water is permitted to be impounded

The methods of control after the impounding of the water consists in stocking the pond with top minnows stranding the driftwood and floatage by direct methods and by lowering and raising the pond and oiling the pond whenever anopheles breeding is found This is done by installing a tank in a boat filling the tank one half full of oil then pumping the tank full of air thus placing the oil under high pressure and then by means of a nozzle attached a high pressure spray is obtained which is most effective The spray breaks into a film when it strikes the water Working with the wind the oil can be thrown two hundred feet This method is the result of necessity Mr Albert Killebrew Manager of the Houston Power Company Newton Alabama who had built a pond before the regulations were effective found himself faced with the necessity of controlling mosquito breeding and assisted by Dr T H D Griffitts of the United States Public Health Service evolved this spray tank

Wherever malaria has developed we have used the standard treatment of quinin In some instances we have distributed the quinin free and in other places we have provided it for the people at cost We have advised the executives of every project to use quinin as a prophylactic measure among all of the people who come to work in the basin before the waters are impounded and upon all the population immediately contiguous to the impounded waters who have been found to be carriers of malaria

The control of malaria around Mitchell Dam a project of the Alabama Power Company on the Coosa River has been almost one hundred per cent With the shoreline aggregating two hundred sixty miles there have been during the year five cases We have been able so far to control these cases so as to prevent the spread

Altogether field investigations have been made and anti malaria measures put in operation in thirteen non health unit counties This brings the proportion of the total area of the state benefited by malaria control measures to 57 per cent

COOPERATIVE EFFORT IN MALARIA WORK

The state program for the control of malaria in Alabama is the result of cooperation by the United States Public Health Service and the International Health Board with the Alabama State Board of Health The former makes available the services in an advisory capacity of the medical officer in charge of malaria investigation the services of an epidemiologist and an assistant sanitary engineer for field investigations In addition to these an assistant surgeon to make epidemiological studies of malaria in Alabama has been almost continuously assigned to this field

MALARIA CONTROL ACTIVITIES IN ALABAMA*

By S W WELCH M D
State Health Officer
Montgomery Ala

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F [illegible] a d p t f t k	$ 530 72
Tool I mbe a l eq pm t	471 10
F pe	1 164 99
Lab	3 561 7
F m n	449 55
I pect n	3 44
Dl d d t b t	475 57
l d t l	38 85
T t l	$7 427 9

This amount may be divided and charged to the two general classes of work as follows

Malaria C t ol (d in g)	$5 950 62
P at fer u Mo qu to Cont l	1 476 67
Total	$74 7 29

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For this purpose three sanitary engineers from the State Board of Health are available at the request of county health officers for preliminary investigation work and for making surveys and e tablishing grades for drainage projects The health officers are then advised as to the best methods of malaria and mosquito control and the various projects throughout the county are conducted under the direction of the county health officers

Twenty three counties compri ing 38 4 per cent of the total area of the state and supporting 56 per cent of the total population have been thus assisted in handling their malaria problems during 1924

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Lin F t f N w Dit h g
Li [illegible] t D tch M int n
B eed g A [illegible] t d by D t h g
(A r)
App o m t Sq Feet O l d (P r G e n)
B d g A [illegible] t d by O l g or P s Green
(A)
App oxim t C t f W k Ind t d Abo e
P p l t L ing i I fect bl T it ry
App o m t p t g H m th A in S m
M S n d
Sq m l M l T t ry
N mb kn wn E d m M l a Foc
Pl s t k d w th G mb
N mber f N w p p A t l M lar
N mb P c s M l ia Lit t D t b t d
N mb f P p l T ght M l (I dd t on to [illegible] the S ppl m t)
N mbe M l a Le t r (f these———w l hools)
N mb Att d g Mala i Le t
N mb F ld D m at ti
N mb Att d F ld D mo t ti
N mbe M l l E h bit
N mb Att nd g M l E h bit
N mb f t m M l l [illegible] lm Sh w
N mb P pl Sh wn T
R ma k (N t yth g f i t est)

MALARIA SURVEYS AND DEMONSTRATION OF ANTI MALARIA WORK IN SUITABLE COMMUNITIES

In addit on to the surveys made and the county wide demonstrations of antimalaria work in the organized

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* R p t f m M mbe f E h C mm ttee Adm i t t N t l M l Comm tt (Co f N t) meet ng nj tly with S th r M d l A oc t Eighteenth A u l Meet g N w O l La N 24 27 19 4

often become so interested that all the boys insist on being examined and parties of the girls at recess 12 and 16 years old insist on being examined and in some cases the teachers as well.

I make a complete record with a carbon copy. If I *find an especially large spleen in a little fellow* I call the teacher over and let her feel it. Of course her ideas are vague but when she feels a hard mass coming three fingers breadth below the ribs she becomes interested and is a good missionary. I leave the teacher a record sheet of the examination and with that as a text we succeed in having many standard treatments taken.

Two years ago in my round the children told me things like these: We get malaria from dirty ponds, night air, sugar cane, fish in stale water, watermelons in dog days, flies and mosquitoes raised in weeds, pea vines, trees. Now almost any school in the malaria belt will tell you about eggs, larvae, pupae, mosquitoes, how they get malaria, how they transmit it and the essential facts about draining, screening, oiling and quininization. We are rapidly growing a population that will demand health appropriations large enough to do some practical prevention.

We arrange for standard treatments at cost. Some health officers have a fund for buying quinin at cost, selling it at cost and buying more. We are now having one hundred five grain capsules sold for one dollar.

Incidentally as I go through these schools I pick out particularly bad cases of adenoids, the worst cases of hookworm and other defects. I have the teacher who makes the list make a note under Remarks. In this way some other corrections are made.

Our last plan of work is to teach from the theater.

The difficulty in getting an adult audience has led me to write a little comedy called "The Country Cut Ups," embodying my most humorous experiences in health work. A health officer visits a rural school and finds an antagonist audience of parents objecting to the examination of their children. How he overcomes their prejudices and teaches them the principal facts of preventive medicine forms the theme. The school comedians keep the interest keen and between acts I always get a chance to *hammer home local needs* to a large audience. If they will not listen to me I make their children teach them.

MALARIA CONTROL ACTIVITIES IN LOUISIANA*

By Oscar Dowling, M.D.
State Health Officer
New Orleans, La.

While we are not satisfied with our malaria control activities we have reason to feel that a good impression has been made throughout the State and that a large number of communities adjacent to the towns in which the work has been carried on, likewise parishes adjacent to those where the United States Public Health Service investigations have been made, will take *up the work in another year.*

Summarized we find that during 1924 surveys and cost estimates were made for three towns, Merryville, Grand Cane and Vivian, and a proposed real estate subdivision near Shreveport.

Supervisory assistance was furnished for ten local control campaigns as follows: Natchitoches, Baton Rouge, De Ridder, Homer, Haynesville, Mansfield, Minden, Ludington, Bon Ami and Ruston.

Four communities in addition to the above, Monroe, Lake Charles, Elizabeth and Shreveport, carried on campaigns.

Malaria investigations were made in two parishes by the U. S. Public Health Service. These parishes are St. Mary and Tangipahoa.

Early in the summer we determined that the time had come for an intensive malaria educational program. *With this in mind the Superintendent of the* Department of Education was sent a copy of Dr. Carter's very excellent article on Malaria published by the United States Public Health Service and Mr. Harris agreed that it was worth while to have this taken up wherever the Parish Superintendents would like to do so in the schools. It is not obligatory but is named by the State Department of Education as a Supplementary Reader and no doubt many of the *teachers will use the Malaria Primer very effectively.* We have had a large number of requests so far for this little book. It is our purpose to assist financially in this work by supplying the Primer in quantities to the Superintendent of Parishes or principals of schools, so that they may be had by any teacher who will take the initiative in this form of malaria education.

We have issued from time to time about 15,000 leaflets on malaria, those by Dr. Bass and some that *were prepared by the members of our own force.*

Beginning with January 1 we expect to make an earnest effort to give supervisory assistance to communities asking for it and to assist otherwise communities that desire to put on malaria programs.

The malaria death rates in Louisiana 1918 to 1924 inclusive are as follows:

1918	28.75
1919	24.56
1920	33.95
1921	23.22
1922	21.82
1923	16.65
1924	14.81

Estimated from number of deaths reported to September 30, 1924.

*Report from Member of Sub-Committee on Administration, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Eighteenth Annual Meeting, New Orleans, La., Nov. 24-27, 1924.

The International Health Board has supplied one half the salary of two assistant sanitary engineers for service in connection with the county health units and also contributes valuable council with regard to administrative problems

A conspicuous example of cooperation in field activities was carried out in the government reservation at Muscle Shoals where a microscopist was employed by the United States Public Health Service two medical assistants by the International Health Board motive equipment quinin and the services of one sanitary engineer were furnished by the State Board of Health while the cost of operating the malaria control measures on the lake was borne by the War Department

An effort toward cooperation between the State Agricultural Department Extension Service and the State Board of Health was occasioned by the passage some years ago of an agricultural drainage law Several drainage projects were worked up by the state agencies These have all been held up because of a decision of the Supreme Court calling into question the constitutionality of this law The case is still in the hands of the court

A constitutional amendment was passed on November 4 1924 authorizing the formation of drainage districts in the interest of improved agriculture and public health *The resumption of activities under a new law* will afford further opportunity for a demonstration of the cooperation of several state agencies in field activities for malaria control and agricultural improvement

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MALARIA CONTROL ACTIVITIES IN ARKANSAS*

By M Z Bair
Chief Sanitary Engineer, State Board of Health
Little Rock Ark

Our malaria control program for the past year has consisted in carrying forward our urban units and doing as much as we could in connection with county control work

We have been rather slow in getting our county work under way The primary reason is the low density of population and the proportionately high per capita cost We have been unable to organize full time county health units except in a few counties However considerable educational work has been done in the counties with a view of ultimately getting full time units

We have two counties which will undertake the work two definitely committed to it and one which is practically committed to it but it is not offical They are the more densely populated counties Programs have been tentatively planned for them and we feel that a sufficient amount of money can be raised to do effective work However many of our counties especially in the eastern portion of the state are in the same class as those referred to by Dr Rankin very sparsely populated which together with the absence of drainage makes it a difficult and costly problem A large proportion of the tenant houses are most difficult to screen. In fact it is more than just a screening proposition It is almost a reconstruction problem so far as the houses themselves go

We have held our old urban units and added a number of new ones greatly increasing the urban population protected The results secured have been very satisfactory

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MALARIA CONTROL ACTIVITIES IN GEORGIA*

By M A Fort M D
State Board of Health
Atlanta, Ga

In Georgia we have about eighteen counties doing county health work under the direction of Dr Waller *In three of those counties there are one medical officer* and three non medical officers making four officers in the three counties They are specializing upon malaria

They are doing principally quininization and encouraging screening and trying to get some drainage done The United States Public Health Service and the State Board of Health pay one half of the expense while the counties pay the other half This is the only proposition of the kind which the State Board assists in a financial way

We are in a state that has only three cents per capita appropriation for all health work laboratories and everything else I think most of you have two or three or five times as much as that

We have been trying for years to get an appropriaation for anti malaria work We haven t a cent yet so we are trying to fight malaria without a cent for the purpose Our sanitary engineers of course do what they can

Last year I went from county to county making talks in the principal schools and explaining exhibiting larva charts pictures and distributing literature I have been over the whole malarial part of the state that way in almost every school

This year we felt the need of concentrating a little more so I adopted the method of examining the spleens Now I go to every school in the county and examine every child in the school under 12 years of age They

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*Report from Members of Sub-Committee on Administration National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La Nov 24 27 1924

*Report from Members of Sub-Committee Administration, National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La Nov 24 27 1924

often become so interested that all the boys insist on being examined and parties of the girls at recess 12 14 and 16 years old insist on being examined and in some cases the teachers as well

I make a complete record with a carbon copy If I find an especially large spleen in a little fellow I call the teacher over and let her feel it. Of course her ideas are vague but when she feels a hard mass coming three fingers breadth below the ribs she becomes interested and is a good missionary I leave the teacher a record sheet of the examination and with that as a text we succeed in having many standard treatments taken

Two years ago in my rounds the children told me things like these We get malaria from dirty ponds night air sugar cane fish in stale water watermelons in dog days flies and mosquitoes raised in weeds pea vines trees Now almost any school in the malaria belt will tell you about eggs larvae pupae mosquitoes how they get malaria how they transmit it and the essential facts about draining screening oiling and quininization We are rapidly growing a population that will demand health appropriations large enough to do some practical prevention

We arrange for standard treatments at cost Some health officers have a fund for buying quinin at cost selling it at cost and buying more We are now having one hundred five grain capsules sold for one dollar

Incidentally as I go through these school I pick out particularly bad cases of adenoids the worst cases of hook worm and other defects I have the teacher who makes the list make a note under "Remarks" In this way some other corrections are made

Our last plan of work is to teach from the theater

The difficulty in getting an adult audience has led me to write a little comedy called 'The Country Cut Ups' embodying my most humorous experiences in health work A health officer visits a rural school and finds an antagonistic audience of parents objecting to the examination of their children How he overcomes their prejudices and teaches them the principal facts of preventive medicine forms the theme The school comedians keep the interest keen and between acts I always get a chance to hammer home local needs to a large audience If they will not listen to me I make their children teach them

MALARIA CONTROL ACTIVITIES IN LOUISIANA*

By Oscar Dowling M D
State Health Officer
New Orleans La

While we are not satisfied with our malaria control activities we have reason to feel that a good impression has been made throughout the State and that a large number of communities adjacent to the towns in which the work has been carried on likewise parishes adjacent to those where the United States Public Health Service investigations have been made will take up the work in another year

Summarized we find that during 1924 surveys and cost estimates were made for three towns Merryville Grand Cane and Vivian and a proposed real estate subdivision near Shreveport

Supervisory assistance was furnished for ten local control campaigns as follows Natchitoches Baton Rouge De Ridder Homer Haynesville Mansfield Minden Ludington Bon Ami and Ruston

Four communities in addition to the above Monroe Lake Charles Elizabeth and Shreveport carried on campaign.

Malaria investigations were made in two parishes by the U S Public Health Service These parishes are St Mary and Tangipahoa

Early in the summer we determined that the time had come for an intensive malaria educational program With this in mind the Superintendent of the Department of Education was sent a copy of Dr Carter's very excellent article on Malaria published by the United States Public Health Service and Mr Harris agreed that it was worth while to have this taken up wherever the Parish Superintendents would like to do so in the schools It is not obligatory but is named by the State Department of Education as a Supplementary Reader and no doubt many of the teachers will use the Malaria Primer very effectively We have had a large number of requests so far for this little book It is our purpose to assist financially in this work by supplying the Primer in quantities to the Superintendent of Parishes or principals of schools, so that they may be had by any teacher who will take the initiative in this form of malaria education

We have issued from time to time about 15 000 leaflets on malaria those by Dr Bass and some that were prepared by the members of our own force

Beginning with January 1 we expect to make an earnest effort to give supervisory assistance to communities asking for it and to assist otherwise communities that desire to put on malaria programs

The malaria death rates in Louisiana 1918 to 1924 inclusive are as follows

1918	28 75
1919	24.56
1920	33 95
1921	23 22
1922	21.82
1923	16 65
1924	14 81

Estimated from number of deaths reported to September 30 1924

*Rep t from Membe f S b-Committee Adm i tra tio N t al M la i Committee (Co fere Mala ia) meeti g co j i tly with S th M dic l Associatio El htee th A al Meeti g N w O leans La. Nov 24 27 19 4

All full time health units in the state 8 in number carried on some measures of malaria control during the year

Financial aid was rendered only to the county wide projects already mentioned Advisory aid was at all times available to municipalities and the individual and was freely given through the State Division of Malaria Control

STATISTICAL

(State of Mississippi)

The following data are offered which indicate the course malarial fever has taken in the state at large over a five year period

TOTAL MALARIA CASES REPORTED BY PHYSICIANS STATE OF MISSISSIPPI

(By Y ly Q rt)

	19 0	1921	19	19 3	19 4
1 t Q t	11567	11884	11120	9 89	9424
2 d Q te	22 92	23846	5 92	19787	21164
3 d Q rt	66547	57808	61313	46 64	34_36
4th Q rt	970	7673	00	19382	
T t l	1153 6	121207	10 747	95	
phy i n rep ti g (A l A g)	94 4	96 2	96 4	96 1	96 2

Reviewing the above fi ures and comparing the cases reported for the f rst nine months of the current year with the same period of the preceding year it is noted that there is a reduction in cases reported of 14 4 per cent for the tate at large

Prior to the month of August the number of cases reported was slightly in excess of last year s record

LABORATORY EXAMINATIONS FOR MALARIA

The encoura ng of definite diagnosis of malarial fever has formed part of the plan to control this dis ease

The following table indicates the use that is bein made of available laboratories to confirm malarial d ag noses

BLOOD SMEARS FOR MALARIA (19 4)

	[illegible]	[illegible]	[illegible]
Fi t Q rt			
St t Hyg l L b to y	609	1	1 97
B ll ty	80	141	17 68
Co hom Co ty	14		4 93
For t Co ty	26	0	0 00
J es C ty	12	0	0 00
Lee Co ty	25	0	0 00
T llah tch Cou ty	6	1	16 67
Y zoo Co ty	109	1	0 92
TOTAL	1731	16	9 30
Seco d Quart r			
State Hygi ic L bo t ry	886	4	5 08
B llva Co ty	1446	647	44 74
Coahom Co ty	2 5	29	10 65
F est Co ty	87	13	14 94
J es Co ty	43	2	4 65
Lee Co ty	33	4	1 12
T llah h Co ty	125	12	9 60
Y oo Co ty	79	9	11 39
TOTAL	2974	761	25 59
Third Qua ter			
State Hygi i Laboratory	1182	[illegible]	4 16
B livar Co ty	1996	801	40 13
Co homa Cou ty	362	4	11 60
F rrest County	137	9	6 57
J es Co nty	100	2	2 00
Lee Co ty	118	3	27 11
T llah tch Co ty	130	12	9 23
Y zoo Co ty	41	6	14 63
TOTAL	4016	961	23 68
Total f Yea to D t	8721	1874	21 49

Th f eg i g tabl i l d o ly f rm tion which is ll bl from ep rts r nd d to th St te B ard of Health

Y oo Co nty h a rt-t m lth fficer employi g sta d d f ll-t m p rso l All th t es recorded b f ll tim h lth dep tm nts

EDUCATIONAL

There is no doubt that the gradual lessening of ma laria cases in the state is due in no small measure to the educational work done in public schools and normal schools through the press and state health department literature and by the various means used by personnel engaged in controlling the disease

Prior to the present year literature pertaining to malarial fever offered by the State Board of Health consisted of but one small pamphlet rather technical and above the ready understanding of the average per son whom it was desired to reach

During the year three circulars and one bulletin were p epared and distributed.

Circular No 1 is in the form of an advisory notice and explains the protective measures which are ad visable when it is inadvisable to institute general con trol measures This circular was mailed to road builders railroads engineering f rms and others who are required in the pursuance of their work tempo rarily to spend time in low lying swampy areas

Circular No 2 outlines the menace of roadside bor row pits from the standpoint of malaria dissemination Cop es were mailed to known persons in Mississippi who are engaged in work which might require the borrowing of earth and to each railroad operating in the tate Letter requests were received from 16 rail road offices for this circular

Circular No 3 deals with mosquitoes and by use of a simple outline segregates the breeding areas character of breed ng which m ght be expected from each area and a practical control measure which applies to each area

Health Bulletin No 22 entitled Malaria and our Fr endly Enemy the Mosquito is prepared in non technical language setting forth clearly the hab ts of those mosquitoes of importance to us and the general facts relating to malarial fever Its preparation is such that it is valuable for school use

At the present time another malaria bulletin is in preparation and about ready for the press

No opportunity has been negl cted to further the use of the standard qu nin treatment and in part cular the continuance of treatment until a cure is effected. Where this was done in connection with control work a marked increase in the sales of quinin sulphate was noted and a decided decrease in the sales of chill tonics Efforts

to have quinin available for purchase in plantation *commissaries and cross road stores have also been successful*

MAN MADE MALARIA

Special attention has been given to the creation of artificial anopheles breeding areas. Many persons engaged in highway construction were cautioned regarding the digging of borrow pits left undrained and Federal and State Laws affecting such violations made known to them. Several railroad companies were dealt with relative to anopheles breeding areas created by them along the right of way and State Laws affecting such health nuisances were brought to their attention. Every railroad operating in Mississippi and every *Board of County Supervisors in the State* a number of individual contractors and the State Highway Department have been requested to give particular attention to the proper drainage of borrow pits and advised of existing laws affecting the creation of mosquito breeding areas within the State. Most encouraging results have been noticed.

CLIMATOLOGICAL CONDITIONS

The entire mosquito season was relatively free from rainfall the total departure from normal for the first nine months of the year being minus 9 02 inches and for a like period last year the total departure from normal was plus 11 94 inches which gives 20 96 inches of rainfall less for the period in 1924 as compared to 1923

It is noted that of the 9 02 inches of rainfall below normal 7 37 inches fell during the third quarter of the year

Just what bearing the lack of rainfall has had on the trend of malaria in the State is difficult to say and it is also speculative as to the effect the dry weather of this year will have on the disease next year

1925 PROGRAM

The distribution of malaria by counties throughout *the State of Mississippi is generally known*

The personnel employed on malaria control work this year consisted of two men each conducting a county wide control project. In addition one of the men served as Director of Malaria Control looking after all projects requiring investigation and advisory aid and handled the detail work in the central office

For work in 1925 it is planned to increase the state malaria control personnel to four men one to serve as state director and the remaining three to carry on work in counties which have full time health units and a malarial problem of sanitary importance

Before instituting control measures a study of the distribution of the disease throughout the county will be made. This knowledge is considered as absolutely necessary before effectively directed control measures can be undertaken. Such work will be carried on in a predetermined systematic manner. The director of the full time unit is considered to be in charge of all health work in the territory under his jurisdiction and should malarial fever present a problem of sanitary importance *to his people it is considered to be his duty* to give this disease the consideration which it warrants

Where malaria is of sanitary importance it presents a large and difficult problem and aid from the state health department is most essential to assist in studying the problem to determine the most effective method for handling it

It is not profitable nor is it wise to make hasty surveys depending upon morbidity data and information picked up at random. Such methods when practiced result in a waste of time and money and are almost certain to produce dissatisfaction among the local population *should inadequate control result therefrom which* can hardly otherwise be expected

It is known that malaria is hardly ever evenly distributed throughout a district in this country. Even in the extremely malarious sections spots are to be found where there is little or no malarial fever

Before instituting control measures the problem must be investigated and studied. Data collected from investigational work will be extensive and can be best used if symbolized and the work directed from maps and charts thus obtained

The county must necessarily be divided into districts and each district subdivided. By progression the extent of the malarial problem must be determined in each subdivision district and county as a whole

Such survey work should extend through an entire year embracing all the seasons as the problem will present different aspects during the several seasons

Such is the program planned for 1925. Working in cooperation with directors of *full time health* units sanitary engineers of the state health department will make the surveys map the districts record all data and from the information secured work out a practical control program. It is readily seen that such procedure will determine the extent of the problem the foci of infection the practical means of control that can be employed and indicate *how the problem should* be handled to gain the most for the least possible expenditure

Large sums of money are not thought necessary for the control of malaria even in the delta section of Mississippi. With accurate information which can be intelligently interpreted showing the distribution of *the population the productive areas* of anopheles and other pertinent information an annual working budget of a few thousand dollars will suffice to control this disease provided the work is systematically carried on uninterrupted over a period of years

During the period when investigational surveys are being made intensive educational work will be carried on

The control of malaria is largely a problem to be solved by the people affected. The 1925 program also includes having the individual to do certain work which is clearly his responsibility for the protection of those persons affected by conditions existing on his premises

MALARIA CONTROL ACTIVITIES IN MISSOURI*

By Cortez F Enloe M D
State Health Commissioner
Jefferson City Mo

The following brief summary of our malaria problem I believe will assist in giving a better understanding of our condition and an evaluation of our activities Malaria in Missouri is not a state wide problem but is confined properly to several counties in the southeast section of Missouri commonly known as Southeast Missouri Localized outbreaks occasionally occur in the adjoining hill counties but these are not endemic foci of infection Infection is brought to these sections by cotton pickers returning from the lowland and these constitute the bulk of cases Occasionally however an outbreak will occur in other portions of the population but it usually wears itself out in a season without any organized effort at control The seven southeast Missouri counties known as Southeast Missouri are practically all reclaimed swamp lands Prior to the beginning of drainage operations in 1907 the land was sparsely settled except for a few ridges which were quite densely populated As drainage progressed the timber was cleared and the land put under cultivation At first general farming was the main pursuit but of late years it has been transformed into a cotton growing country Drainage operations were temporarily halted by the war and the agricultural depression which followed These operations have again been resumed The State Board of Health began its anti malaria activities in this section in 19 1 at which time a survey was made of representative sections of this area The Public Health Service and the International Health Board assisted in financing the survey and also supplied two malaria epidemiologists A program of control must embrace the following activities (1) Further drainage of the undrained areas (2) control of the St Francis River and (3) ditch maintenance These alone in the end will eradicate malaria However they can be hastened and augmented by control of the individual and his immediate environment These latter activities can be carried on only through some existing local health organization preferably a county health department

ADOPTION OF ANTI MALARIA MEASURES BY A COMMUNITY

Several new drainage districts have been organized and drainage operations are rapidly progressing In a large measure these are for agricultural purposes but I believe it is safe to say that our educational work in malaria control has been quite a factor in hastening the work The St Francis River remains a problem difficult to solve Firstly it has been declared a navigable stream and is under the control of the War Department Secondly it is too large a problem to be handled by drainage districts and lastly it will involve some legislative action on the part of both Missouri and Arkansas The situation so far as Missouri is concerned has been improved by the digging of a ditch on the Arkansas side Through some fortuitous circumstance the main waters of the St Francis River have been diverted into this ditch thereby partially solving our problem A ditch maintenance fund has been advised by the State Board of Health for several years but until recently we could not obtain any results the reason in part being that most ditches were new and as yet had not become overgrown with vegetation The main reason however was that those sponsoring drainage projects advised local authorities to spend available money on ditch construction and leave maintenance for the future The Little River Drainage District the largest drainage district has been reorganized and refinanced The plans call for an expenditure equal to the original investment Most of this amount will be spent for ditch maintenance and for the building of smaller laterals Another large drainage district has recently created a ditch maintenance fund and they are making some progress towards the clearance of ditches As a result of our work three full time county health departments were organized in 1921 two of which are still in operation but one of which was discontinued at the end of its first year of operation A fourth county now has the proposition under advisement and we expect its appropriation before the first of the coming year Sentiment is rapidly growing in the fifth county and undoubtedly this county will be organized within another year The health officers in our full time counties experienced great difficulty in developing sentiment for malaria control the reason being that the reduction had been very great following the construction of the ditches and the citizens believed the problem would ultimately be taken care of through this means Educational work was about all we could do for the first year In all of the schools malaria courses were given using Carter's Primer as a text

MALARIA SURVEYS AND DEMONSTRATIONS OF ANTI MALARIA WORK IN SUITABLE COMMUNITIES

The preliminary survey mentioned above was conducted in 19 0 abstracts of which appeared in the Journal of the American Public Health Association and the Public Health Reports In addition the health officers sent questionnaires to families and practicing physicians to determine the actual cases. Spleen and blood examinations of the school children are now in progress Soon we will have a true index of the present conditions During the winter and next summer we propose to carry on local farm drainage work and other local control activities The local health officers have by means of dipping and mosquito identification fairly well outlined the principal breeding areas They have induced most of the druggists to stock standard quinin treatment which is being dispensed to patients practically at cost The local practicing physicians are

*Report from Member of Sub-Committee on Administration, National Malaria Committee (Conference on Malaria), meeting jointly with Southern Medical Association, Eighteenth Annual Meeting, New Orleans, La., Nov. 24-27, 1924

aiding the health officers in popularizing this remedy One county health officer has dispensed free of charge a limited amount of quinin through his office He has induced a large number of plantation owners to dispense this remedy to their tenants The county farm agents are cooperating in bringing about local farm drainage and stocking ponds with top feeding minnows

COOPERATIVE EFFORT AT MALARIA CONTROL

The hardware dealers are recommending and pushing the sale of 16 mesh screen We have no exact figures on the amount of improvement in screening but it has been estimated at about 50 per cent The accomplishments in the creation of a ditch maintenance fund has already been mentioned Other districts are showing interest in this activity and we believe they will follow the lead that has been taken Two towns have adopted local control measures One is fostered by the Lions Club and the other by the city council A demonstration is being conducted in the creosoting of tenant houses If this proves successful there is no reason why it cannot be extended to the majority of tenant houses in the area We expect to carry on this work intensively during the coming year The State Board of Health has established a central public health laboratory at Jefferson City where we are doing slide examinations for the local health officers and practicing physicians It is our intention to establish a branch laboratory near this malarious region during the coming year and thereby further stimulate the use of the laboratory as a means of diagnosis In the past the laboratory as a means of diagnosis was used very little Continued fevers were given the therapeutic test and if they failed to respond to quinin they were called typhoid fever Practically all chills were called malaria We have employed an epidemiologist who is giving a good portion of his time to studies in this area and he has already made great progress toward the discovery of individual foci of infection and stimulating local interest in eradicative measures A questionnaire is being sent to every physician reporting a malaria death This questionnaire in brief asks for complete data on which the diagnosis of malaria was made

SUMMARY

Our malaria problem is confined to a small area of Missouri known as Southeast Missouri This is practically all reclaimed swamp land The principal items in our control program embrace the following (1) further drainage of swamp lands (2) control of the St Francis River (3) maintenance of the ditches already constructed and those to be constructed This program can be made more effective and be given greater application by further control of the individual and his immediate environment For the purpose of bringing this about and promoting general health we are organizing full time county health units in this area The United States Public Health Service and the International Health Board are assisting us in the organization and maintenance of these departments Through these units we are conducting the following activities (1) Education (2) detailed epidemiological studies to find out existing foci of infection and carrying out such measures of control as screening quinization creosoting of houses and individual farm drainage At present our central laboratory at Jefferson City is providing laboratory service for this area We propose to start a local branch laboratory which will do more intensive laboratory work on malaria

MALARIA CONTROL ACTIVITIES IN NORTH CAROLINA*

By W S RANKIN M D
State Board of Health
Raleigh N C

We are carrying seven counties in North Carolina on our malaria program These counties go in on a two year plan with a total appropriation of $10 000 each That is about $70 000 a year Next year we shall continue to carry seven counties All the counties that do the work go into it with a full time department

While I spoke earlier today rather discouragingly as to definite results obtained in this work (questions of that sort having been raised by Dr Ferrell not by the counties themselves) I think the counties are thoroughly satisfied Two years ago when one of the counties went into the program the man who had more influence politically there than any one else opposed it He was elected in November to Congress He went to the health officer this year without solicitation and without expecting anything in the way of return as he had been elected and said

If I can do anything for you this year I would like to go before the county commissioner and advocate this program I have been sold to the work That is indicative of the feeling of the people in the counties

MALARIA CONTROL ACTIVITIES IN SOUTH CAROLINA*

By JAMES A HAYNE M D
State Health Officer
Columbia S C

There are fourteen counties in South Carolina with fully organized county health departments In ten of these counties there is a malaria problem The other four are more fortunately situated

It has always been difficult to induce the county health officers to undertake malaria control work on a county wide basis The reason for this attitude is somewhat obscure We believe it is due to the fact

*Report from Members of Sub-Committee on Administration, National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La. Nov 24 27 1924

that county wide malaria control work is very much more difficult than vaccinating school children giving typhoid fever inoculations or making health talks to schools.

In some counties a prejudice exists against referring to the fact that malaria is present in the county The people who feel this way about it realize that the presence of malaria is economically damaging to the community They realize that malaria has given the county a bad reputation and feel that any attempts to eliminate it must perforce be accompanied by an admission that malaria exists This indifferent attitude on the part of the health officer has been overcome in some of the counties by setting aside a specific portion of the budget for malaria control work with the understanding that a portion of the time of the health organization is to go to the solution of the rural malaria problem To overcome the attitude of the county health officers in those counties where financial assistance is not given to the county budget with the express understanding that malaria control work is to be done it is planned to hold one or more monthly conferences during the year devoted entirely to discussing practical methods for solving the rural malaria problem

In the three counties where assistance is given to the county budget to do malaria work encouraging results have been obtained although the work was late in getting started The fact that we had collected information through the schools during the preceding school term with reference to the distribution of malaria in the county made it easier for the county health officer to locate the foci of infection in the country districts so that all of his time devoted to malaria could be spent in applying malaria control methods to areas most in need of them

South Carolina is attempting to maintain a county health organization in one of the poorest counties in the state where the population is less than 19 000 and three fourths of these are negroes leaving barely 5 000 white people to carry the burden This is a concrete example of the white man s burden We feel that if a success can be made in this county the county health organization can succeed anywhere We are at present *by no means* certain that success will attend our efforts particularly since there have been three successive crop failures in this section of the state and the county is in danger of losing still more of its white population

In other sections of the state where conditions are better and where some malaria exists our experience has been that the conditions causing malaria are much more easily remedied These counties do not have the extensive swamp areas that other counties have The per capita wealth is higher and the wealth is more equitably divided than in the more malarious counties having so large a percentage of the negro population

MALARIA CONTROL ACTIVITIES IN TENNESSEE*

By C B CRITTENDEN M D
State Department of Public Health
Nashville Tenn

The major malaria belt in Tennessee lies between the Mississippi and Tennessee rivers in the western division of the state At present there are no state funds available for aiding in this work except by the personnel of the Division of Sanitary Engineering

Anti malaria work in Tennessee as carried on by the State Department of Public Health is under the supervision of the Divisions of Sanitary Engineering and of Rural Sanitation

The former division functions by making original mosquito control surveys chiefly of towns and small cities submitting recommendations and estimates of costs for the necessary remedial measures and in so far as time will permit, inspecting control and progress during the mosquito season

A number of towns in west Tennessee where malaria control work has been done in the past through financial help from the State Health Department and other outside agencies namely the Federal Government and the International Health Board have continued the work from year to year After funds from cooperating agencies have been withdrawn some of these towns including practically all of any importance in west Tennessee are Covington Millington Dyersburg Union City Humbolt Jackson and Martin

Of special interest is the work being done in Shelby County where an active campaign has been in progress since the spring of 1923 A competent and progressive inspector is provided from local funds who has had the assistance not only of the State Health Department but of the Malaria Field Headquarters of the United States Public Health Service located in Memphis as well Interest has been maintained through the organization of the Shelby County Anti Malaria Association and nearly every community in the county has been reached A malaria school census has been made and the usual mosquito control measures have been instituted

Other mosquito and malaria control campaigns in which the Division of Sanitary Engineering was interested were conducted at Columbia and Cowan At the latter place assistance was given by the N C and St L Railroad which maintains a round house and machine shop coal chute and freight yard at that place and many of the population of which are railroad employes A large amount of ditch draining was required which was done chiefly with dynamite The cost of the work

* Abstract of Report from Member of Sub-Committee on Administration National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Eighteenth Annual Meeting New Orleans La., Nov 24 27 1924

which amounted to $7 500 was borne jointly by the following parties

Tennessee State Health Department	$1 500 00
Town of Cowan	500 00
T M Stewart owner of property with large pond	2,000 00
Five residents of Cowan $100 00 each	500 00
Nashville Chattanooga and St Louis R R about	3 000 00
	$7 500 00

The malaria and mosquito work carried on through the Division of Rural Sanitation is accomplished by the full time county health units which are affiliated with that division There are at present two counties in West Tennessee with full time county health departments Gibson and Obion In Gibson County a preliminary survey has been made some general educational work carried on in connection with community organizations and quinin distributed to cases of active malaria In Obion County a school survey has been made general mosquito control measures instituted and general educational measures carried on

MALARIA CONTROL ACTIVITIES IN TEXAS*

By MALONE DUGGAN M D
State Health Officer
Austin Tex

Organized malaria control in Texas was first started in 1920 with the International Health Board the United States Public Health Service and State Board of Health cooperating in the formation of three units each under the supervision of a sanitary engineer and aggregating twelve cities with a population of approximately 40 000 The former two agencies contributed the directors and aided the cities directly by augmenting the funds raised locally In 1921 the arrangement was continued on the same basis the only change being the addition of several more towns to the units The year 1922 saw the partial withdrawal of the cooperating agencies and the assumption of some of the burden by the State Board of Health This arrangement allowed only two field directors one furnished by the State Board of Health and one by the International Health Board and precluded any expansion maintenance of the old towns being all that was attempted

Early in 1923 the state legislature appropriated $17 500 to be expended in two years upon malaria control This allowed expansion upon the solid foundation afforded by the demonstration units Immediately more field directors were made available and the number of towns doing malaria control was increased to 30, doubling the number and more than doubling the population protected The second year in which the legislature's appropriation was available 1924 saw a further increase to 70 cities doing malaria control and protecting a population of 900 000 or 60 per cent of the total urban population of the State

This work was accomplished with a force of five engineers and inspectors who gave a part of their time to malaria control and five students who were employed during the summer for the purpose of assisting the anti malaria activities The State's expenditures for 1924 were $10 000 plus $3 000 contributed by the *International Health Board* *All of these funds were* expended on salaries and expenses of the field representatives no assistance being offered to the towns other than advice and supervision

The cost of malaria control to the cities amounted to a total of $54 951 00 a per capita cost of 6 1 cents These costs may appear low to the workers in other states However Texas is favored by nature in several ways in the matter of mosquito control As a whole the country is well drained swamps are few and major drainage operations are not necessary The summers are dry as a rule thereby requiring less minor drainage and cutting oiling costs It has been found cheaper to apply oil a few times in the spring and fall than to *construct and maintain ditches and do extensive stream* rechanneling

Malaria control in Texas cities is complicated by the demand for the control of all mosquitoes Particularly has this been true since the dengue epidemic of 1922 However all anti mosquito control campaigns conducted under the supervision of the State included efficient anopheles control A city may be rated as obtaining mosquito control but the partial applies to the pestiferous and dengue carrying mosquitoes only perfect anopheles control being required Some cities particularly the larger ones such as Houston and Dallas direct the bulk of their anti mosquito control work against anopheles

The local organization that applied the anti malaria measures was of course varied according to local conditions Wherever possible the work was carried on under the supervision of a full time inspector or foreman Of the 70 cities 22 were able to employ full time men In 10 cities the local health officer gave direct supervision City marshals performed this duty in 8 other cities In the balance of the cities mosquito control was carried out under the direction of a part time man usually a city employe sometimes a meter reader a street foreman or city secretary It has been found more conducive to continuation of the work from year to year to train a permanent city employe than to advocate the hiring of a man on a part time basis for the summer only

A comparison of the number of cases of malaria reported from the state as a whole indicates a downward trend of malaria probably due to the extension of anti malaria work During the first eight months of

* Rep t from M mb f b Committee Adm ist tio N t on l M l l C mm tt (Co f M l) meet ng o jo tly with S th n Med l A oc t Eighteenth An ual Meet g N w O le La N 24 27 1924

TEXAS CITIES DOING ANTI MALARIAL WORK

T wn	P p l t n	Typ f C t l	C t f W k	Loc l Dl ecto
Wa o	50 000	[illegible] mpl t	$ 5000 00	Full t m
D llas	175 000	A ph les	,600 00	Full t me
W h hie	8 000	Compl t	1050 00	Full t m
E	7 000	Complete	175 00	Pa t tim
M l n	6 000	Compl te	515 [illegible]	Full tim
M t	3 500	C mplete	120 [illegible]	P rt tim
[illegible] svill	9 000	C mpl t	150 00	C ty h lth of
D nt	8 000	C mplete	250 00	P t t m
M ia	15 000	Compl t	60 00	[illegible] t tim
Terr ll	8 500	[illegible] t l	160 00	P rt t m
K fm n	3 000	[illegible] mpl te	200 00	M te m n
Worth m	2 500	Compl te	200 00	M ter man
K	2 000	Complet	2 5 00	P rt tim
T gu	3 500	A ph l	120 00	P rt tim
Blooml g Grov	1 100	Complete	120 00	C ty m rsh l
F ost	1 100	C mplete	100 00	C ty m rsh l
Hillsbo	7 000	C mplet	600 00	Full t me
M dl thi	1,300	P ti l	50 00	P rt t m
Alva d	1 400	C mpl t	75 00	P t tim
Al d	1 800	P rt l		[illegible] y S outs
Co ic	0 000	P ti l	225 00	P t t m
Smith ille	3 500	P tial	60 00	City h lth f
T yl	6 500	P ti l	625 [illegible]	P rt tim
Geo g town	8 000	C mpl t	[illegible]	C ty h lth of
B h m	5 500	C mpl t	6 5 00	Full tim
Elgi	1 700	P tial	115 00	M t m
B tlett	2 000	C mplet	250 00	C ty h lth f
Cam on	5 000	P t al	150 00	P t tim
B y	7 000	Compl t	620 00	
Coll g St t o	3 000	Compl t	650 00	Full t me
N sota	5 000	Complet	375 00	Full t m
Seg	3 700	C mplet	960 00	Full t m
Lockh rt	4 000	Compl t	270 00	P t t e
Som ll	1 500	C mplet	3 5 00	P rt tim
H	3 000	C mpl te	850 00	F l t m
C l t	2 500	C mpl t	25 00	C ty m shal
Rockdal	2 500	Compl t	150 00	[illegible] rt t m
G ov t	1 200	C mpl te	440 00	C ty m rsh l
A tin	40 000	A ph les	1000 00	[illegible] S meter
M	1 000	Con pl t	100 00	P t t m
L l g	4 000	C mpl t	840 00	F ll t m
E tla d	10 000	Compl t	1800 00	[illegible] ll t m
Cla kes ll	4 000	Compl t	000 00	F ll tim
Sherm	17 000	A ph l	1123 [illegible]	F ll t m
H y Gro	3 000	Compl t	300 00	C [illegible] o m h l
P l	17 000	A ph l	300 00	C ty g
Gree ill	14 000	Complet	500 00	F ll t m
F m rs ill	2 500	Complete	250 00	City h lth f
Whit ight	1 000	C mplet	300 00	[illegible] y
M Ki y	7 000	Compl t	500 [illegible]	City h lth f
Plano	1 500	Complet	00 00	M y b ts
F isc	900	Complet	500 [illegible]	C ty h alth f
C l	1 200	Complet	[illegible] 00	[illegible] t t m
Al d	1 400	2 m th	100 00	C ty m rsh l
Mt. Ple t	4,500	A ph l	300 00	P t tim
N ogdoches	4 000	C mpl t	1555 [illegible]	F ll t m
Jackso ille	6 000	C mpl t	435 00	F ll t me
L fki	7 000	[illegible] rti l	140 00	F ll tim
C ork tt	4 000	Complet	670 [illegible]	City m rsh l
T i ty	1 500	C mplet	400 00	C ty m rsh l
Li l gsto	1 200	C mpl t	3 5 00	P t t
G p l d	1 200	A ph l	83 00	C ty h lth of
Alto	1 200	C mpl t	390 00	C ty m rsh l
H derso	2 500	Compl t	[illegible]	F ll tim
Lo gvi w	5 000	[illegible] t l	225 00	P t t m
Tyler	15 000	P ti l	119 00	F ll tim
M rsh ll	18 000	Compl te	1760 [illegible]	F ll t m
Ce ter	1 200	P ti l	80 00	P t tim
Sa A to i	165 000	Complete	8800 00	F ll t m
Hou t	140 000	A ph les	5000 00	F ll t m
Total [illegible] ities	898 200		$34 951 00	

Note—Complet co trol d notes t l of ll peci f mos q itoes.

A oph les co trol d tes co t l f ph k ly P rt l co trol denotes mplet f ph k l p ti l co t l f th pecies.

1923 reports of 14 759 cases were received The same period of 1924 resulted in only 12 755 cases but the latt r year represents a larger number of reports

Ow g to its proximity to Mexico it has been deemed necessary by the United States Public Health Service to in ure safety from a yellow fever epidemic by [illegible] tablishing a control belt against the aedes aegypti mosquito alon the border This has been a work of no small magnitude More than 50 cities and villages have established mosquito control under the supervision of the Public Health Service Undoubtedly this work reduces malaria al o though the territory covered does not lie in the most malarial section of the state

No malaria control on a county wide basis was attempted in 1924 except such activities as were incidental to the regular functions of county health units In eight counties campaigns of education were carried on in cooperation with the part time county health officers and school superintendents for the purpose of arou ing public entiment for malaria control and perhaps will lead to the adoption of anti malaria measures in the future by county commissioners This work has been in the nature of an experiment and no conclusions can be drawn as yet Incidentally close to 100,000 pieces of mosquito literature were distributed in towns and counties A new mosquito film was purchased and many lectures were given

MALARIA CONTROL ACTIVITIES IN VIRGINIA*

By L L Williams Jr M D
State Board of Health
Richmond Va

(1) *School History I dex*—School history index to measure malaria was taken in 192? and 1923 and is now being taken for 1924 The cards are carr ed to the teachers who distribute them to the school ch ldren the card be ng filled in at home by the parents The reporti g of malaria by local physicians and the discovery of foci by county health officers has checked so favorably with the school history index as to cause the malaria department to make this an annual activity

(2) *Anopheles Obser t ons*—Anophel s observations were made in n ne count [illegible] by full time health officers and sanitary officers In the early seasons crucians were found to predominate with punctipennis close econd and quadrimaculatus few In the mid lle of the season quadrimaculatus predom nated and the latter part of the season the crucians and punct pennis predom nated as in the early part of the season In the counties with a low malaria incidence crucians and punct pennis predominated throughout the season In counties with high malaria in idence quadrimaculatus predom nated in malaria season In two counties where there was very little malaria but with heavy breeding hatchings showed nearly all to be crucians, with a few quadrimaculatus at the he ght of the malaria season In

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*Abstract f Report from M mbe I S b-Committee Admi i trati N tio l Mal l Comm ttee (Co ferenc M l ia) meeti g co j i tly w th South rn Medical Association E ghteenth A l Meet g New O leans, La N 24 27 1924

been made in any of the cities where malaria control projects have developed to control malaria through distribution of quinin advocation of the tandard treat ment or any other measures that might properly be the function of a medical health officer

The work has not yet developed on a county wide scale for the reason that none of the counties in which work has been done have regular county health organi zations And none of the counties where malaria con stitutes a rather serious problem are likely to develop a county health unit solely for the purpose of engaging in county wide malaria control It appears that county wide malaria control in Illinois is dependent entirely upon regular county health organizations establi hed primarily for the control of communicable diseases in general the problem of county wide malaria control becoming a part of the work embraced by such an organization

Malaria control in Illinois although a *comparatively* new venture has enjoyed a steady growth ince its in ception In 1922 a community control campaign was conducted at Carbondale in 1923 campaigns were con ducted at Carbondale and Belleville in 1924 cam paigns were conducted at Carbondale Belleville and Herrin and in 1925 it is probable campaigns will be conducted in two or three additional cities

CARBONDALE PROJECT—1922

Carbondale a city with a population of 6 267 is located in Jackson County 56 miles north of the junc tion of the Ohio and Mis issippi Rivers In 1922 the Lions Club of that city with financial a sistance from the International Health Board and the Illinoi Central Railroad Company undertook an anti malaria and mosquito campaign Other organization a ide from the State Department of Public Health which cooperated in the work were the United States Public Health Service State Natural History Survey and the City of Carbondal

Physicians e timates during the previous years howed the malaria morbidity rate of the city to be about 300 cases or 4 7 per cent per year In 1922 a hou e to house canva s revealed 189 cases for 1920 and 267 ca es for 1921

About 60 acres of cat tail swamps were draine l by dynamited ditches *In the course of the campaign* 4 45 miles of ditches were cleaned regraded and maintained 140 miles of ditches and lake edges oiled 12 small ponds drained 584 open wells and cisterns and remain ing lakes and ponds tocked with Gambu ia and 8 hou e to house in pections made The total co t of the work exclu ive of state upervi ion was $2 798 53 or about $0 44 per capita

The results of the work were extremely gratifying In addition to securing almost complete relief from the mosquito nuisance a substantial reduction in malaria cases was made Physicians estimated at the end of the season that there had been 54 ca es chargeable to Car bondale as compared with 300 durin preceding years From a house to house canvass only 10 cases were revealed for the eason compared with 267 and 189 cases determined by house to house canvasses for the two preceding years

The total economic saving effected over 1921 was estimated to be $18 500 00

CARBONDALE PROJECT—1923

In 1923 the work was continued under state super vision without outside financial assistance During the season 176 miles of ditches and lake edges were oiled 3 house to house inspections made and the swamp drain age completed The total cost of the work exclusive of state supervi ion was $1 437 55 or about $0 23 per capita

At the end of the eason physicians estimated that there had been 22 cases chargeable to Carbondale From a house to hou e canva s only 11 cases were revealed

The total economic saving effected over 1921 was estimated to be $24 000 00

CARBONDALE PROJECT—1924

During the past season the work was again continued Owing to the financial condition of the city the local Lions Club was forced to bear the entire expense of the campaign The oiling work was continued until September 1 when the anti mosquito fund became de pleted The total cost of the work was $477 12 or $0 076 per capita

Local phy icians have estimated that there have been 44 cases chargeable to Carbondale With one more physician to be heard from it i likely that the 1924 cases will exceed 50

Th total economic saving effected over 1921 is esti mated to be approximately $21 000 00

BELLEVILLE PROJECT—1923

So successful was the work at Carbondale that Belle ville a city with 24 741 population located 17 miles outhea t of St Lou in St Clair County undertook an anti malaria and mosquito campaign Financial a si tance was secured for the fir t year s work from the International Health Board

While malaria in Belleville is not considered to be a serious problem and the mosqu to nuisanc was respon ibl for the control work statist cs indicated that the city suffered approximately 1 per cent malaria morbid ity rate From a house to house canvass of 1608 resi dences representing a 6853 p pulation 49 cases were revealed for 1922

During the summer 286 miles of ditches and lake edges were oiled 7 acres of marsh land drained and one complete house to house in pect on made

The total cost of the work was $3020 56 or $0 12 per capita

At the end of the season a can ass of the 1608 resi dences which were canvassed in the spring was made and 6 cases of malaria revealed ind cat ng a substantial reduction

The total ec nomi a ing effected over 1922 was estimated to be $3 600 00

BELLEVILLE PROJECT—1924

Dur ng the past season the control work was con ducted by the city without outside financial assistance The oil ng work was continued and house to house in spections were made The total co t of the work wa $1710 96 or $0 0 per cap ta No estimates of malaria cases for this year ha e been prepared but from the standpoint of el minat ng the mo quito nuisance the work was entirely successful and provi ions ar be ng made for continu g the work during 1925

HERRIN PROJECT—1924

Herrin with a populat on of 10 986 is located in Williamson County 13 miles ea t of Carbondale Con trol work was tarted this year by the c ty a d local civic organ zat ons a sisted financially b the International Health Board

In 1920 physicians estimated that there had been 247 cases of malaria in the city During thi year a house to house can ass reveal d 234 cases for 1923

Because there were some mar hes adjacent to the cit created by the coal mine water supply reservoirs wh ch could not be drained complete control could not be secured During the course of the campaign several small ponds and mar hes were drained 2 miles of d tches cleared and regrad d approx mately 140 m les of d tches and lake edges were oiled other marshes were treated w th Par s green and two complete hou e to h use inspections were made

The total cost of the work was $2483 00 or $0 2 5 per capita

From a house to h u e canva s made in October 66 cases were revealed ind catin a ubstantial reduction in malaria

The total econ mic savi g effected over 1923 s est mated to be $14 100 00

DE PLAINES RIVER PROJECT—1922

The most notable project conducted in the state and not directly under state supervision was the Chicago Sanitary D tr ct project along the Desplaines River in 19 2 Purely a project d vorced from malarial con sideration 72 square m les were pl ced under cont ol at a cost of approximately $1250 per square mile In 1923 although the work had been very successful no provision was made for the work in the San tary Di trict s appropriations but the work was carried on to some extent individually by some of the cities and ommunities which ha l received benefits the previou year

THE FUTURE OF MALARIA AND MOSQUITO CONTROL IN ILLINOIS

The work thu far carried on in Illinois has proved successful as is evidenced by the facts that it has en joyed a steady growth and that no city where work has been started has allowed it to lapse in the succeed ing years The work furnishe a good foundation for further exten ion

Future plans include the earliest po sible d velop ment of the county health un t so that malaria con trol may be conducted on a county wide cale in th e countie where malaria constitutes a erious problem and th exten ion of the malaria control d monstrations to other cities

La t year in the heavily populated districts adjacent to Ch cago mosqu toes became so troublesome that a great deal of interest over the ubject of mosquito con trol was developed Indications are that legislation af fectin the work and providing for the legal establish me t of mosqu to control d tricts im lar to drainage and s n tar districts will hortly be enacted In the e ent of such favorable legislation it is apparent that malaria and mosquito control work will have recei ed a great stimulu in Illinois

In connection with the probable de elopment of anti mosquito p ojects in northern Ill no s the Department of Health has conducted some experiments with Gam busia in Cook County It has been the impression f r some time that Gambusia could not survive the long col t winters of northern Illinois While this fact not et pro ed or d proved t s a f ct that Gam bu a placed in se eral ponds in Cook County i the fall of 1923 are present in noticeable numbers in the fall of 1924 If it d velops that Gambusia are able to survive and reproduce in northern Illinois it is likely that the m nno s will play an important role in the control projects which are to develop in that section

From pre ent information it is likely that Carbon dale Belle ille and Herrin will continue the control work during 1925 The city of Pekin has indicated that it will also undertake control work. With these projects in v ew and the po sibility that one or two additional cities may be encouraged to carry on the work pro pects for 1925 control work are good While the w ork has not developed as rapidly as perhaps it would we e Illinois confronted with the same malaria problem as the South there is encouragement in know ing that the work has met with favorable public re sponse has been successful in all of the projects under taken and has contributed to the contention that it is a grow ng field of endeavor

SYMPOSIUM ON MALARIA

Papers and Reports Presented at the Conference of the National Malaria Committee, Meeting Conjointly with the Southern Medical Association, at Dallas, Texas, November 9-12, 1925

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SYMPOSIUM ON MALARIA

REPRINT FROM
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J l f th S th rn Med l As l tı n
B rm gh m Al b m
V l XIX M y 19 6 N 5
Pages 363 407

SOME FEATURES OF MALARIA CONTROL*

By W E DEEKS M D
General Manager Medical Department
United Fruit Company
New York N Y

In the light of our present knowledge we are forced to the conclusion that we cannot hope to eradicate malaria in the near future from most infected districts To do so would necessitate either the destruction of all malaria transmitting mosquitoes in low lying areas throughout the world between the latitudes of 40 south and 60 north (a task impossible of fulfillment) or else the discovery of a plasmodical agent capable of destroying the parasites in the host in all stages of their developmen

It is a fact that in many districts in this and other countries malaria has been practically eradicated The contributing factors in this accomplishment have been first the drainage and cultivation of the soil involving destruction of a large proportion of the mosquito breeding places and reduction of the Anopheles index to such a degree that the possibility of transmission was minimized second our increasing knowledge of the various problems connected with the prevention and cure of malaria and the utilization of that knowledge by most of the inhabitants of the districts

Our hope for the future lies in the general adoption of these measures Therefore to this end there should be compulsory education which should embrace a knowledge and application of the general principles of sanitation and of the methods of malaria prevention In the meantime all that we can expect in most malaria infected districts is the intelligent application of recognized and reasonable measures of control

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*Ch irm n Add ess Nati l M la ia C mmittee (Co f on M la i) m ti g c njoi tly with So th rn Medical A soci tio Ni tee th A nual Meeti g D lla T N 9 12 19 5

PREVENTION AND CURE

A discussion of the problems concerned in the control of malaria must consider the disease from two standpoints namely prevention and cure In the present state of our knowledge there is but one known method of preventing infection by malaria and that is to avoid being bitten by a malaria infected mosquito Consequently either mosquitoes which transmit malaria must be destroyed in some of their life phases or we must protect ourselves against being bitten by them As to the first proposition this unfortunately is practicable or possible only in some few limited localities Because of the breeding habits of Anopheles mosquitoes the destruction of their larvae becomes a problem of the greatest magnitude and in many districts the expense involved in such a method could be justified only under extraordinary conditions As to the second proposition (protection against the bite) this can be accomplished only by living in effectively screened houses or through the proper use of bed nets

The flight of the Anopheles mosquitoes in search of warm blood begins about sunset and most of them feed before nine o clock However they will sometimes continue to feed until sunrise During this period a person must have complete protection against the bite of the Anopheles Both screened houses and bed nets are absolutely useless unless advantage is taken of their protection during the entire period between sunset and sunrise We know that a great many individuals who live in screened houses contract malaria The fault lies not in the screening if this has been effectively done but with the individual in not seeking protection during the hours when the mosquitoes are actually searching for food Naturally ' bed nets are not so effective as screened houses for the reason that people do not as a rule take advantage of their protection until late in the evening after the majority of the mosquitoes have fed In this connection in malaria infected districts emphasis should be laid on the necessity of screening all buildings utilized at night for business purposes or for public gatherings If these buildings are left unscreened they are fruitful places for malaria infection Another important precaution is to prohibit public gatherings in the open after sunset

QUININ PROPHYLAXIS

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SYMPOSIUM ON MALARIA

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*Ch irman Add tional Mala ia Committee (Co f M la ia) m eti g n nj intly with South rn Medi l As oci tion Ni teenth Annu l Meeting Dallas Tex 9 1 19 5

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malarial infection, and a great many theories were advanced as to how this drug could be given most advantageously Some authorities recommended the taking of small doses daily while others advocated that larger doses taken once or twice weekly were most effective Recently, however Yorke and Macfie and others have demonstrated beyond any question of doubt that no amount of quinin taken before exposure will prevent a malarial infection *either by direct inoculation or infected blood or* through the bites of infected mosquitoes The wastage of quinin which has been given for prophylactic purposes in the past has been enormous and in the light of our present knowledge this practice should be discontinued The only case in which the administration of *quinin for prophylactic purposes is justified is* that of a non immune person who is known to have been exposed to infection Under such circumstances quinin may be taken in generous doses for from ten to fourteen days subsequent to the period of exposure But it is problematical whether it is not better to withhold the administration of quinin until premonitory symptoms develop and parasites are demonstrated in the blood and then administer *quinin in sufficient quantities and over a* sufficient period to effect a cure If we begin the administration of quinin with the belief that we have a malarial infection, and the symptoms disappear within two or three days we are prone to discontinue the quinin before a sufficient amount has been taken to effect a cure and thus permit our patient to drift into a chronic condition

In this connection however we should state that in infected communities the continuous administration of quinin in modest doses daily or twice weekly will prevent acute exacerbation thus enabling the infected individuals to continue at work and avoiding the necessity of hospitalization This method of procedure will also serve another purpose by clearing the peripheral blood of parasites we prevent mosquito infection and thus to a certain degree control the spread of *the disease* This measure is of value in certain emergency labor conditions but we have demonstrated in our divisions that such methods do not sterilize the individuals or lower to any degree the percentage of infections and hence cannot be considered as a permanent measure of dealing with community infections

IMMUNITY

It has been definitely proved that many individuals and some races are definitely immune to malaria, and that the degree of immunity which exists in others varies tremendously The severity of the symptoms and also the facility with which the disease is cured will depend upon the degree of immunity or resistance to malarial infection in each individual In every malarial district these facts must be taken into consideration as there is no way of determining the degree of immunity or resistance possessed by individuals until infection has actually taken place In some individuals with high resistance nothing more than rest in bed with or without a laxative is sufficient to clear the parasites from the blood in an acute attack In such cases if some drug has been administered *we are prone to attribute the good results to the* direct effects of the drug instead of to the high degree of resistance or partial immunity possessed by the patient

TREATMENT

The treatment of malarial infections depends upon a variety of circumstances We know that the severity of the different types of malaria varies In the order of gravity of symptoms we must place estivo autumnal tertian and quartan In the *facility of cure* this order is reversed Moreover the asexual forms are eliminated from the peripheral blood much more readily than the gametes

A consideration of the treatment of malaria necessitates its division into two classes first those of primary infections and second those of the chronic and relapsing cases The recent work of scientific investigators has proved beyond the question of doubt that primary infections are readily cured This work was stimulated largely by Gerstmann who initiated the method of treating patients suffering from general paralysis dementia precox disseminated sclerosis etc by infecting them with malaria either by inoculation or directly through the bites of mosquitoes Many of these patients had not previously had malaria so that exact information was obtained as to the period of incubation individual degrees of resistance and the amount of quinin necessary to obtain a cure

From this work it has been fully demonstrated that primary infections are readily cured by quinin if treatment is promptly administered and the dosage need not necessarily be large Apparently from 5 to 15 grains

3 times a day over a period of from 10 to 14 days was sufficient to effect a cure. In fact in some of them where resistance to infection was high no medication was necessary to free the peripheral blood from parasites. The natural defensive agents of the body were able to take care of the infection. Some malariologists like Pijper and Russell believe that most tertian infections are promptly cured in the primary stage by intravenous injections of neo-arsphenamin. This is contrary to the experience of most clinicians in this country though undoubtedly neo-arsphenamin plays an important role in the cure of some chronic cases. We do not believe that there is any known drug as effective as the salts of quinin in the treatment of acute primary infections and in the great majority of cases the oral administration of from 10 to 15 *grains three times daily over a period of from* 10 to 14 days suffices to bring about a cure. There are some malariologists too who believe that even smaller doses are sufficient but that will depend on the degree of resistance or immunity possessed by the infected individual.

In some individuals whose resistance is low and in whom no degree of immunity exists the symptoms are liable to be extremely severe. In these cases in order to save life we must resort to the use of quinin either intramuscularly or intravenously in doses of from 7.5 to 15 grains repeated if necessary every four hours until the malignancy of the symptoms disappears. Subsequently the oral administration of quinin can be carried on until the patient is cured which in primary infections should occur within two weeks. If a temperature continues high more than five days in spite of the proper administration of quinin some other complicating condition should be suspected.

CHRONIC AND RELAPSING CASES OF MALARIA

The chief difficulties connected with the eradication of malaria rest with these cases. They are reservoirs of gametes and thus a perennial source of infection for mosquitoes. If we were able to cure our chronic carriers malaria would soon cease to be a serious problem. In many localities anopheles mosquitoes practically disappear during the dry season and there is a corresponding lull in the spread of malaria, but with the onset of the rainy season new breeding places are formed and under such favorable conditions propagation is rapid. The newly-developed mosquitoes in their search for warm blood become infected from these old carriers or reservoirs of malarial infection and are thus able to spread the infection to others.

In the past insufficient attention has been given to the cure of cases of chronic malaria. Cases become chronic from a variety of reasons among which may be mentioned first that during the treatment of primary infections quinin has not been given over a sufficient period of time or in adequate quantity to effect a cure and second that a low degree of resistance on the part of the patient prevents his throwing off the disease. Low resistance on the part of the patient is caused by various conditions which prevent the natural defensive agents of the body from functioning to their maximum capacity. Among the common conditions which lower the resistance of the patient may be mentioned:

(1) Acute and chronic infections such as syphilis, tuberculosis, amebiasis, uncinariasis, etc.

(2) Chronic organic or degenerative disease of all kinds.

(3) Focal infections.

(4) Unbalanced and deficient diet in consequence of which the individual suffers from malnutrition.

CASE REPORT

In order therefore to cure chronic malaria in any individual every effort must be made to diagnose the complicating conditions and give the appropriate treatment to obtain any progress against the malarial infection. Unless this is done in many chronic cases no amount of quinin administered in any way over any period of time will suffice to effect a cure.

An educated white man who had lived in the coast climate of Guatemala for eighteen years had a case of persistent tertian malaria. He had suffered a great deal from malaria and at intervals had taken large amounts of quinin and arsenic. His recent history was as follows:

In July 1923 he became quite ill with malaria, a mixed infection, and was given a course of quinin. He took 45 grains daily for 10 days and 30 grains daily for six weeks subsequently. During the latter part of this period he was in Europe. While there he stopped taking quinin for about a month and then had another malaria attack with two definite chills on alternating days, after which he again resumed his quinin. He continued to take 30 grains daily until about the middle of January in 1924. Meanwhile in November he had returned to the tropics where he lived under excellent sanitary conditions in a screened house and was very little exposed to reinfection.

During the early part of March his tertian malaria symptoms again returned. For two weeks he took 45 grains daily, then 30 grains daily for eight subsequent weeks, and 10 grains daily for several weeks longer. While still taking 10 grains daily he fell ill with malaria about July 12 and went back to 45 grains a day for three weeks, subsequently continuing to take

30 grains of quinin daily This he kept up for three months when the dosage was reduced to 20 grains daily which he continued to take until February 1 25

About this time he felt very achy in the limbs suffered from lassitude and malaria like symptoms, and a thick film examination of the peripheral blood revealed a tertian gamete After a consultation with several physicians he was advised to take 30 grains of quinin daily 5 m of Fowlers solution three times daily and 0 5 ounce of Warburgs tincture with aloes three times daily This was kept up for fully five weeks when the Fowlers solution was discontinued and a weekly injection of arsphenamin given instead In addition to this twice a week he took intramuscular injections of 15 grains of quinin replacing evening doses by mouth

On Monday April 13 he was playing golf in the sun when he had a moderate chill and went to bed with a temperature of 103 F He complained of pain in the spleen which on examination was found to be slightly enlarged It proved to be a typical tertian paroxysm The next afternoon his temperature rose to 100 5 F and the following day to 100 F With this recurrence on Monday April 13 all previous treatment was discontinued A purge was given and he began the use of stovarsol taking four tablets during the first 24 hours and three daily thereafter until 25 had been taken

Two weeks thereafter the patient reported that he felt better than he had in many moons His tongue which had been filthy for over a year was almost clean his appetite was better than it had been for months and the tired feeling in his legs and shoulders had practically disappeared

On October 9 1925 the patient reported at my office after a prolonged vacation in Europe and stated that he was now feeling better than he had felt in a great many years

CONCLUSIONS

In the case discussed it will be noted that stovarsol appeared to give the necessary "kick which quinin neo arsphenamin and Fowlers solution were unable to do to bring about convalescence The success obtained by stovarsol in this case naturally led us to try the drug in many others In some of the chronic cases the results were very satisfactory but in most of the acute cases we were compelled to resort to the use of quinin in order to save life It is interesting to speculate as to why stovarsol in the case referred to above was responsible for a result that quinin was unable to effect

Up to recent times the belief has been general that quinin was directly plasmodicidal i e that it had a selective destructive action on the malarial parasites Muehlens and Kirschbaum exposed malarial cultures to solutions of quinin in strengths of from 1 to 2 500 and 1 to 5 000 for variable periods of time and from these cultures were able to inoculate individuals with malaria They also similarly investigated the effect of the arsenical preparations upon malaria cultures with corresponding results Owing to these investigations we are forced to conclude that neither quinin, arsenic, nor probably any other known drug directly destroys malaria parasites They do so only in conjunction with some agent or agents in the body Cushny states that when quinin is injected into the blood it leaves the plasma within a few minutes, becoming attached to the corpuscles in some firm combination from which it is difficult to liberate it and that only about one third of the quinin administered is eliminated by the kidneys If quinin forms a direct combination with the hemoglobin of the red blood cells this may have some inhibitory effect on the growth of the parasites in the cells or again may render these cells more readily subject to phagocytosis This also would help to explain the difficulty of destroying gametes as when they are completely developed there is little or no hemoglobin left to enter into combination with quinin

We must appreciate the fact that every animal survives because of his defensive agencies which enable him to combat his external as well as his internal enemies (microparasites and macroparasites) After disease germs gain access to our bodies with the host they enter into a combat or struggle for existence, and man survives because of his natural defensive agencies These are many and elusive In the case of malaria probably the macrophages are chiefly concerned though opsonins and other humoral substances may also directly participate According to Kolmer the macrophages consist principally of the larger mononuclear leucocytes ameboid cells of the spleen and lymphatic glands alveolar cells of the lung endothelial cells of the serous cavities and lymph spaces bone corpuscles and giant cells of bone marrow and embryonic connective tissue cells It is well known that the large mononuclears are always increased in number in a malarial infection

The malarial toxin suddenly liberated when sporulation occurs undoubtedly is toxic to cells in the human organism as shown by the reactionary fever which is nature s way of stimulating metabolic activity to develop defensive agencies Some macrophages are destroyed by the toxins but in conformity with Weigert s overproduction theory' overproduction of them immediately takes place to meet the next toxic onslaught According to Kolmer sev

eral compounds are believed to stimulate phagocytosis both *in vitro* and *in vivo*. Among these are calcium, magnesium, mercuric chlorid, quinin, strychnin and arsenical compounds. It is possible, therefore, that quinin not only acts by stimulating phagocytosis, but that it may also have some direct action in combining with the hemoglobin of the red cells with which it enters into chemical combination.

We have always felt that in an acute attack of malaria the administration of a preliminary dose of calomel and magnesium sulphate has a beneficial effect. It is quite possible that their action is not confined alone to elimination. They may also have some stimulating action on the defensive agencies. The arsenical preparations, in addition to stimulating leucocytosis, are supposed also to act in stimulating the activity of the bone marrow in the formation of blood cells. In the treatment, therefore, of chronic malaria, it is not wise to depend upon quinin alone, as the case reported above fully demonstrates. Different drugs and different preparations of the same drug apparently vary in their action on the defensive agencies of the body. When one drug does not prove effective in bringing about convalescence another may. In several acute cases the results from the administration of stovarsol were encouraging, but in most of the cases we were compelled to resort to the use of quinin in order to save life. However, in chronic cases the results were much more encouraging. Some physicians have strongly recommended the use of mercurochrome in the treatment of malaria. We have given this drug a thorough trial and from our experience we can only conclude that in acute cases mercurochrome is without value, but in certain chronic cases of malaria with specific complications mercurochrome has a beneficial action.

SUMMARY

We must place our reliance upon quinin in some form for the cure of acute malaria.

In chronic relapsing malaria better results are obtained by combinations of quinin, arsenic, iron and strychnin than from quinin alone.

All complications or debilitating conditions associated with chronic malaria must receive appropriate treatment if we are to obtain optimum results.

In communities where it is impracticable to destroy all breeding places of Anopheles mosquitoes, it is possible to contend satisfactorily with the malaria problem only by educating the entire population to such an extent that they will realize the necessity of maintaining properly screened quarters and remaining in them during the hours between sunset and sunrise.

Screened buildings should be provided for all those engaged in night work, and also for evening public gatherings of all kinds. The holding of public gatherings in the open after sunset should be prohibited.

Every effort should be made to detect and cure persons infected with chronic malaria, as the elimination of these carriers will break the cycle of infection and hence assist materially in reducing the malaria rate in the community.

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IMPOUNDED WATERS AND MALARIA*

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The utilization of water power is not like the consumption of coal; it does not lessen a natural resource of the country. It is a true conservation of wasted power and adds to the permanent assets of the country. Also it is a mighty factor in the development of the country much in excess of the money cost of the projects. If the reservoirs and ponds of these power developments are a serious menace to the public health they cannot be allowed. Our aim is to ascertain the extent of damage, if any, to the health of communities by the creation of ponds, and to determine what regulatory measures are necessary to obviate such damage.

Thus spoke the late Dr. Henry R. Carter, Assistant Surgeon General, United States Public Health Service, at the beginning of studies in 1914 under his direction of the relation of impounded waters to the incidence of malaria in the South. Two things were necessary. There must be no turning back in the damming of

*Read before the National Malaria Committee, Co[illegible] [illegible]ence o[illegible] Mala[illegible] [illegible] m[illegible] [illegible] jointly with [illegible] th[illegible] [illegible] Med[illegible] [illegible] Associ[illegible]tio[illegible] [illegible] th[illegible] [illegible] Meeting, D[illegible]la[illegible] T[illegible] [illegible] [illegible]9-1[illegible] 19[illegible]5.

streams for power development and the health and lives of the people must be protected

Hydro electric power companies had already created extensive reservoirs with the one idea in mind power for public or private use The Federal Government had likewise dammed a Southern river for navigation purposes leaving in its backwater trees brush logs and flotage—the Anopheles' idea of 'the home beautiful They had not been told for no one possessed the knowledge for advice that the troubles and expense were not over when flood rights had been acquired the dam erected and the 'white coal' was converted to power or navigation was open Morbidity reports were filed not so much with the health board but with power companies in the form of litigation wherein damage to health on account of malaria was alleged There was a veritable epidemic of damage suits North Carolina had them South Carolina had them Alabama had them and others were threatened with serious outbreaks

These 'growing pains caused justified alarm and as an immediate result of litigation scientific research into the relation of impounded waters to malaria was begun by the United States Public Health Service The unsung and much scarred veteran of many campaigns against yellow jack and other maladies of the tropics and sub tropics directed these studies with the delving analytic deductive mind of the medical scientist and the constructive mind of the engineer (he being both an engineer and a physician) So when Henry Rose Carter died in Washington D C September 14 1925 he had lived to see waters impounded for the greatest development of the South industrially and the public health conserved

Our investigations extending over a period of 11 years and covering artificial and natural lakes and ponds and streams in five States gave valuable information not only on the role of impounded waters in relation to malaria but on the entire subject of malaria transmission in the United States Through these researches the following facts were elicited

(1) By changing flowing streams into bodies of quiet waters the biology (to be more exact the entomology) of such waters is radically changed All over the South fresh water streams and springs (at a temperature as low as 64 F) produce Anopheles *punctipennis* a species of mosquitoes proven capable of transmitting malaria experimentally under artificial conditions These same streams dammed and transformed into quiet bodies of water add to their production Anopheles *quadrimaculatus* the great malaria mosquito if not the sole natural purveyor of this disease in the South

(2) Generally the amount of Anopheles mosquito production in new ponds is dependent upon the amount character and location of flotage (leaves bark finely broken twigs etc) on the surface of the water whether along shore or resting on water which is 10 fathoms deep

(3) Pond breeding Anopheles mosquitoes (*quadrimaculatus*) enter occupied houses at night in large numbers where production is large The stream type (*punctipennis*) enters such houses relatively rarely but bites out of doors mostly at night

(4) The Anopheles *quadrimaculatus* will fly a mile in quest of a meal of blood

(5) Epidemics or serious prevalence of malaria adjacent to impounded waters in the Southern States are not recorded where the prevailing species of Anopheles mosquitoes was other than *quadrimaculatus*

(6) The impounding of water generally greatly reduces the production of summer broods of Anopheles *punctipennis* in the area occupied by the pond

(7) If not properly treated imported laborers and others who are already harboring malaria parasites brought into or remaining in the project area increase the danger of malaria prevalence (There must be parasite carriers for the mosquitoes to bite before new cases of malaria are possible)

(8) Certain measures taken before the impoundage to reduce floatage and the application of anti larval (wiggle tail destruction) measures on the pond result in certain prevention of malaria

The enforcement of statutes rules and regulations for the protection of the lives and health of the people in each State comes under the police power of the State a function not delegated by the States to the Federal Government In the case of regulations for the impounding of water the health authorities duties are primarily to see that proper safeguards are thrown about the people Their privileges are two fold—protection of the public health and assistance in a tremendously important, legitimate industrial development Alabama Georgia South Carolina and Virginia have adopted regulations the basic principles of which are similar Alabama coming first alphabetically we will mention some of the details of the requirements in this State

Any person firm corporation county or municipality desiring to impound water or who propose to raise the level of an existing pond shall prior to the initiation of any construction activities make application to the State Board of Health in writing for and obtain from it a preliminary permit for the impounding This applies to any pond from one tenth of an acre up provided there is any permanent human habitation congregation or place of business within one mile of any portion of the proposed pond

The outstanding virtue in all of the regulation is the provision aiming at the reduction of flotage on the pond and this is contemplated in the following

In the area to be occupied by the reservoir its

branches, lights and indentations, all brush, trees, undergrowth, logs, stumps and similar objects which, if not removed, would float or collect flotage on the surface of the impounded water, and all of the above mentioned that are lying on the ground or remaining in new or original position which would probably cause collection of flotage and thus constitute conditions favorable to the protection of larvae of mosquitoes capable of conveying malaria, shall be removed, burned or otherwise satisfactorily disposed of prior to the impounding of the water.

The foregoing does not include grass, vegetation, brush, trees, stumps, etc., which will be permanently and completely submerged at the time of low water. Among other requirements are the provisions for drainage of pools left in the pond area at low water stage, clearing of the draw-down area, establishment of small ponds for the development of top minnows (gambusia), etc. All of the section relating to preliminary preparation of the area of impoundage need not apply when, in the opinion of the State Board of Health, they are not necessary. After the preliminary requirements have been complied with, approved by the State Board of Health, and the water is impounded, a permit is issued for maintaining an impounding project, the validity of which permit is contingent upon certain specified measures being enforced to prevent anything detrimental to public health or likely to cause an increase of malaria.

As an example of the magnitude of the operations required to sanitate a large project area and concomitantly to create a beautiful lake, the Alabama Power Company is nearing the completion of Cherokee Bluffs dam on the Tallapoosa River, 42 miles from the State Capital, which will create a lake covering 40,000 acres and having a shore line of 700 miles, the largest artificial lake in the world. It would take one walking 10 hours a day one month to cover the distance on the maximum contour from one end of the dam to the head of backwater and back to the other end of the dam. If there were a concrete road around the shore line and the same speed laws were enforced that maintain in the towns in this section, it would take one five days to motor around and back to a given point. An airplane could circumnavigate it in a day, but could neither take off nor land at any given point on this rugged line.

This vast area of forest and field is being prepared in accordance with expert knowledge and regulations. The water level of this lake will vary 60 feet, or from elevation 490 to elevation 430. This itself is one of the greatest safety factors against production of malaria mosquitoes. This zone is cleared like a new ground for cultivation and nothing will be left to protrude above or rest on the surface at elevation 430, the extreme low water. To do the clearing more than 3,000 men have been employed during the past year. Every employe undergoes a physical examination, a blood specimen for malaria parasites is taken from each, and each man signs an agreement to abide by the company's health rules.

Enormous sums are now being expended by hydro-electric power companies in the preparation of basins and in health work on completed projects, and there are in several states outstanding demonstrations of excellent health conditions where, without having complied with the standards set up by the U. S. Public Health Service and regulations promulgated by state boards of health, malaria might have run rife and industrial assets might have dissolved into liabilities. Power companies are realizing the value of having standards set by legally constituted health authorities in order that they may be complied with and no negligence can be charged. Specimens of the species of the genus *homo* who are willing to go to any length to harass and extract money from the corporations continue more nearly to reach the period of extinction. Hydro-electric health is now becoming an established institution in the South.

DISCUSSION (Abstract)

D. M. A., Fort Bainbridge, Ga.—I would like Dr. Griffitts' opinion of the best and most economical way to handle a project on Spring Creek in Decatur County, Georgia.

The dam of the power company was destroyed by the floods of January and February, 1925. There has been no rain of account since then and the water has been very low all summer. Investigating at intervals I occasionally found a few *quadrimaculatus* larvae in the holes in the creek bottom, none in the creek itself, and no adults in the homes on the hill.

The dam was repaired in late summer and the pond slowly began to fill up. In early fall the homes for a mile from the pond were full of *quadrimaculatus*; they were found in hollow trees all the way to the pond, and larvae were found all over the pond in flotage. The pond is five or six miles long, one quarter mile wide, and full of large and small trees and bushes. If we required this growth to be removed, it would bankrupt the company. Gambusia are scarce since the flood. The stage is all set for an enormous production of *quadrimaculatus* next spring.

Can Dr. Griffitts suggest a feasible way of controlling this pond?

Dr L D Fricks U S P H S, Memphis Tenn—Nearly all we know about this subject Impounded Waters and Malaria is the result of studies conducted by the Public Health Service Carter LePrince and Griffitts have contributed most of this information Studies of impounded waters in relation to malaria have been conducted by the service in the Southern States for more than 10 years and as Dr Griffitts has pointed out we know the general principles involved in the impounding of waters as they relate to malaria and the general measures which should be applied for the control of mosquito production in and malaria around these projects

There is only one phase of this subject which I desire to call to your attention at this time It has sometimes seemed to me that the relative importance of large impounded water projects in relation to malaria can be easily exaggerated as compared with the smaller ponds and breeding places of malaria mosquitoes The Public Health Service found it convenient to spend most of its time in the study of the larger impounded water projects in relation to malaria and most of the published reports deal with the larger bodies of water But the fact that the studies were made generally speaking of large impounded water projects should not lead us as public health officials to ignore the smaller closer and perhaps more dangerous malaria producing bodies of water which are to be found on the outskirts of our towns and in the immediate vicinity of the farmers homes

Dr S W Welch Montgomery Ala—The State Board of Health of Alabama believes that top-minnows are the first line of defense against malaria It is the policy of the board to require all corporations impounding water in the State to stock the ponds plentifully with gambusia while the water is being impounded We do not rely solely upon minnows We require oiling under certain conditions and quininization in others We believe so strongly in the standard quinin treatment that a question dealing with the standard quinin treatment is asked at every examination given by the State Board of Medical Examiners to applicants for certificates to practice medicine in Alabama We do not think that any one measure can be relied upon to control malaria but we do believe that top minnows is one of the best measures we use

Dr Griffitts (closing)—It is not practicable to advise Dr Fort on a feasible way of controlling the pond he refers to without basing the advice on first hand knowledge of conditions I am not in favor of what might be termed dry footed advice on malaria prevention We have been able however to greatly reduce *quadrimaculatus* production in some uncleaned ponds by forcing boats through and applying oil under high constant pressure With the dam out only a few months there may be a marked decrease in flotage next season and a proportionate decrease in Anopheles breeding A word as to gambusia and other top-minnows there are times and conditions when they are similar to no trums—90 per cent advertising and 10 per cent predation

OBSERVATIONS ON THE MALARIA PROBLEM OF TODAY*

By Frederick L Hoffman
Consulting Statistician Prudential Insurance Co,
Newark N J

The progress which the South has been making in malaria eradication is amazing For the Southern States combined the malaria death rate has diminished from 12 4 per 100 000 in 1917 to 5 7 in 1923 In the Mississippi delta which for many years has been intensely a malaria region and which has a population of over 400 000 the number of cases of malaria has diminished from 64 000 in 1915 to 38 000 in 1924 The number of deaths has diminished during the same number of years from 656 to 182 Similar progress is reportable for most of the centers of malaria infection which have given so much serious concern in the past

But while the problem is one of less concern today than in former years it remains as the outstanding health question of the Southern States Neglect in matters of precaution particularly mosquito extermination and isolation of carriers easily leads to a return to former conditions What we are most in need of at the present time is the active cooperation of business organizations and large corporations having a vital interest in the health of the community I would therefore, suggest to you and most urgently the appointment of a special committee on publicity and cooperation whose duty it should be to enlist such cooperation as may be available in different sections of the country and give the widest dissemination to the available information on malaria prevention and control If such a committee should be appointed I would be very glad indeed to assist in every way possible What remains of malaria in the Southern States is none the less a serious problem regardless of the progress that has been made The disease is unquestionably today of a milder type but it continues to complicate practically every important cause of death Even mild forms of malaria impose an enormous economic loss upon the community I will not venture into the realm of conjecture by estimating the annual loss especially to plantations but it

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Nineteenth Annual Meeting Dallas Texas Nov 9 1 19

must reach in some sections in considerable proportions. Many areas of great productive possibilities are undeveloped because of the malaria factor. Many cities and towns are non-progressive on this account. From a real estate point of view malaria is probably the greatest of all hindrances.

I would fail if in this connection I did not give expression to my profound appreciation of the excellent work that has been done by the United States Public Health Service in keeping the facts of the malaria situation and the methods and means by which it may be improved continuously before the public. But we are in need of a still more aggressive policy if the remaining evil is to be dealt with to the best advantage of all concerned.

OPPORTUNITIES FOR PROGRESS IN MALARIA ELIMINATION*

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Those of us who have been occupied with public health activities for a number of years realize that it takes considerable time and effort to arouse and maintain public interest in sanitation, and that it is frequently difficult to measure the result of strenuous effort. On the other hand, it is possible to arouse considerable interest without being able to know how much good we have really accomplished. Any expression of popular approval of sanitary accomplishments must follow the selling of the value of applied sanitation to those directly benefited, i.e., to those who control the industrial purse strings.

With regard to malaria control, our biggest problem is to determine the best way to get the public to become active in assisting the person directing control measures. By the public is meant the individual, the community and the group of communities that make up the county.

There is a possibility of the health worker's trying to do by himself what many others could be made willing to do for him, and of thus accomplishing what he is trying to do, and having it done in a much shorter time, and hence at less expense to the general public.

While it is wise and proper for a county health officer or his assistant to spend considerable time trying to persuade one or more property owners to screen their homes or drain some sources of Anopheles, yet how much more satisfactory it would be if other persons voluntarily did this for him and caused the sanitation converts to come to the health officer for advice as to procedure. Could, or would, such a scheme work?

Today our malaria is confined largely to that part of the South where cotton is grown. In a large section of this territory, and where the best cotton crops are raised, these crops are financed by our banking institutions, and the bankers as well as the planters incur considerable risk because of the malaria hazard. The risk can be largely overcome by applied sanitation, but we sanitarians have failed as salesmen to present this fact in an effective way to the bankers of the cotton belt. We can rely on the bankers taking all necessary precaution to protect their loans, and it should be our business to show them how such risks can be reduced. No banker loaning money on a cotton crop desires a reduced yield due to labor inefficiency, and we should show him how this can be overcome at minimum expense so that he may profit by it.

Assuming that a committee of bankers come to you tomorrow morning and asked you as a health officer what you could recommend as the least expensive measures to protect the farm labor and thus insure the repayment of farm loans by a good crop in a highly malarious district, what answer would you give them? What would you suggest that they require of the cotton planter in connection with the bank loan to be made that would not embarrass the planter?

Some investigations made by the United States Public Health Service in the most malarious sections of the Mississippi delta have brought out several startling facts:

(1) The cotton plantation owners in general are of the opinion that it is not practical to prevent negro farm tenants from abusing the screening placed on tenant houses.

(2) The negro tenants often pay almost as much for bed nets or mosquito bars as it would cost to keep their homes effectively screened.

(3) Where the need of proper care of the screen has been properly explained to the negro tenants, they have

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taken better care to keep the screen intact than is done by white farmers owning their own homes

(4) The item of proper persuasion is the key to the situation

It is possible that in most instances negro farm tenants can be protected from malaria by the screening of their homes and that in most instances the cost will not be much above what the tenants are now paying for bed mosquito bars In many instances the negro farm tenants after understanding the situation have promptly and willingly given their time and labor toward the effective mosquito proofing of their homes

Our railroads are intensely interested in the size of the crops produced the amount of cotton agricultural products lumber and freight to be hauled

The Cotton Belt Railroad made a decided profit by carrying on a malaria campaign and it was not long before the Missouri Pacific and Rock Island Lines started similar campaigns because of the potential profits that are apparent

If we ask the question why the railroads in this section of the malaria belt are doing intensive anti malaria work profitably while the railroads in the other malarious sections are ignoring present and future profits what would the answer be? It is as plain as a flag staff Sanitarians have failed to sell the idea to the general managers of railroads east of the Mississippi River

Along our southeastern coastal plain there are thousands of unused acres of good farming land In a large number of instances the failure of the development of this territory is caused by potential or actual malaria prevalence The railroads traversing it have good general managers and active agricultural development agents but they do not know that failure of attempted development is often caused by actual or potential malaria prevalence When the railroad executives wake up to these facts we shall see a decided change in the status of development

Surely we need an active subcommittee on publicity in our National Malaria Committee to get such facts as the e to business executives and commercial interests who can use them and indirectly be of assistance to us in our efforts to get rid of malaria

If such a committee sold the general manager of one railroad we might mention then that within a few years its income through hauling more freight could be appreciably increased and incidentally its reduced actual losses would pay several times what its campaign would cost

We all realize that in malaria infected regions the elimination of this disease will bring increased profits to owners of farm lands to town merchants employers of labor, banking interests lumber operators, insurance agencies, farmers railroads and assist state development associations but these agencies have not analyzed the project yet and we as sanitarians must see that it is our duty to get them to do their part

If any county or state health officer had but a few of these agencies interested in his malaria control campaign there would be no question about the increased rate of progress that would follow A way must be devised to get the business and banking associations to sponsor our efforts at malaria elimination It will mean increased business and increased profits to them

When the Bankers' Association of Arkansas recently cooperated with the Missouri Pacific Railroad and a "Better Health Special" of eight cars was sent to a large number of small communities throughout the state the farmers and their families from distant homes came to the train by hundreds day after day station after station and it indicated most clearly and definitely what can be done by railroads and associations of business men in getting the rural people interested in applied sanitation and malaria control

Now that we have general managers of state boards of development of railroads and officials of a state bankers association interested in our problems in several states west of the Mississippi the outlook is more encouraging It has been clearly demonstrated that it is possible to interest commercial agencies in at least one phase of rural sanitation and that a large amount of constructive work is being done through their efforts It is equally evident that other commercial agencies will be ready to accomplish similar undertakings as soon as their directors understand that such efforts can be so planned and directed as to result in increased profits and increased business There is a golden opportunity awaiting a general committee on commercial relations of the National Malaria Committee The question is Are we going to measure up to this opportunity?

DISCUSSION (Abstract)

Dr W S Leath rs Nashville Tenn—All of us who have been engaged in public health work for the past several years realize that not only has very definite progress been made in the reduction of malaria incidence in those sections of the country where malaria is prevalent but with this achievement there have accrued increased opportunities for continuing the work of malaria control upon an even more effective

basis. One of the most encouraging indications at the present time is the intelligent interest of commercial organizations such as the boards of trade in the respective states in the economic aspects of this problem.

The prevention of malaria is not only a question of improving the health of the people among whom it exists, but it also has a far reaching effect in improving the economic conditions of a locality. There are areas in the Southern States, notably in the Delta of the Mississippi River, which, if freed of malaria, would have enormously increased real estate values. It is already acknowledged that the fertility of the soil in this area exceeds that of any other region in the world and the great need at the present time in improving the industrial and agricultural development of this territory is to eliminate malaria. The achievement of this will be the most significant factor in bringing about not only improved civilization, but in making this large agricultural territory the outstanding region in agricultural production throughout the country. This fact is beginning to reach the minds *of those who occupy positions of leadership in the* business world and there can be no question that in a relatively short time, measured in terms of human accomplishment, malaria will be under complete control throughout the Southern States particularly as well as in other parts of this country. It is imperative in this connection for the health officials of the respective states to continue their efforts along educational lines looking to the achievement of this result in the shortest period possible.

PREVALENCE OF MALARIA (1925) IN PARTS OF DELTA OF MISSISSIPPI AND ARKANSAS. ECONOMIC CONDITIONS*

By M. A. Barber
Special Expert, U.S.P.H.S.

W. H. W. Komp
Associate Sanitary Engineer, U.S.P.H.S.

and

T. B. Hayne
Technical Assistant, U.S.P.H.S.
Greenwood, Miss.

That portion of Mississippi known as the Delta lies between the Yazoo and the Mississippi Rivers, embracing 12 counties. It is a region almost wholly given over to the growing of cotton, one of the counties (Bolivar) producing more cotton than any other county in the United States.

Practically the whole of the cotton crop in this region is grown on large plantations worked by negro labor. Any factor which interferes with the necessary supply of this labor is of great economic importance. The prevalence of malaria, therefore, with its peculiar seasonal incidence, may be a limiting factor in the production of the crop, interfering with the cultivation and especially with the picking of the crop.

This section of the State has suffered an unenviable reputation for unhealthfulness in the past, due in large measure to the prevalence of malaria. It is well known that in any given community the negroes have a higher infection rate than the whites, an important matter in this section in that practically 80 per cent of the population of the Delta counties is colored.

The former prevalence of malaria in this region led us to undertake some work with the aim of getting some definite measured estimate of the amount of malaria present and to secure data on the economic condition of the negro tenant in certain parts of the Delta during the present season of 1925, and to compare our results with other findings obtained some 10 years ago in the same territory.

During the spring of 1925 a number of rural negro school children were examined for malaria parasites, using the thick film technic. One hundred and ninety six children were examined during the month of April, 10 being found positive, or 5.1 per cent. Three had the tertian type and seven had the estivo-autumnal type of malaria. These children were those of plantation negroes. As it is known that wherever malaria is prevalent children are more heavily infected than adults, school censuses tend to show a rather higher percentage of malaria than that of the general population. The results of this survey should be contrasted with the findings of Mayne[1] who during February and March, 1915, just 10 years ago and within 50 miles of our own territory, examined by thick film 1,184 persons, finding 492 infected, or 41.55 per cent. Sixty four and four tenths per cent was estivo-autumnal and 35.6 per cent was tertian. These findings should be compared with ours of 5.1 per cent.

Following up this work, blood examinations were made of negro plantation workers and their families in the vicinity of Greenwood, Miss., and around Lake Chicot in Arkansas, a region lying across the Mississippi River from Greenville, Miss. Two series of examinations were arbitrarily made in each region—one, the non-selected group, including all persons on several of the plantations, and the other, the selected group, being those who at the time of the ex

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*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Nineteenth Annual Meeting, Dallas, Texas, Nov. 9-12, 1925.

taken better care to keep the screen intact than is done by white farmers owning their own homes

(4) The item of proper persuasion is the key to the situation

It is possible that in most instances negro farm tenants can be protected from malaria by the screening of their homes and that in most instances the cost will not be much above what the tenants are now paying for bed mosquito bars In many instances the negro farm tenants after understanding the situation have promptly and willingly given their time and labor toward the effective mosquito proofing of their homes

Our railroads are intensely interested in the size of the crops produced the amount of cotton agricultural products lumber and freight to be hauled

The Cotton Belt Railroad made a decided profit by carrying on a malaria campaign and it was not long before the Missouri Pacific and Rock Island Lines started similar campaigns because of the potential profits that are apparent

If we ask the question why the railroads in this section of the malaria belt are doing intensive anti malaria work profitably while the railroads in the other malarious sections are ignoring present and future profits what would the answer be? It is as plain as a flag staff Sanitarians have failed to sell the idea to the general managers of railroads east of the Mississippi River

Along our southeastern coastal plain there are thousands of unused acres of good farming land In a large number of instances the failure of the development of this territory is caused by potential or actual malaria prevalence The railroads traversing it have good general managers and active agricultural development agents but they do not know that failure of attempted development is often caused by actual or potential malaria prevalence When the railroad executives wake up to these facts we shall see a decided change in the status of development

Surely we need an active subcommittee on publicity in our National Malaria Committee to get such facts as these to business executives and commercial interests who can use them and indirectly be of assistance to us in our efforts to get rid of malaria

If such a committee sold the general manager of one railroad we might mention then that within a few years its income through hauling more freight could be appreciably increased and incidentally its reduced actual losses would pay several times what its campaign would cost

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Dr W S Leathers Nashville Tenn—All of us who have been engaged in public health work for the past several years realize that not only has very definite progress been made in the reduction of malaria incidence in those sections of the country where malaria is prevalent but with this achievement there have accrued increased opportunities for continuing the work of malaria control upon an even more effective

malaria or 16 5 per cent of those examined Table II gives the figures for this group

It should be strongly emphasized that even of this group of malaria cases the disease as a cause of disability was a negligible factor In fact only 16 gave indication of illness from malaria at the time a blood specimen was taken One of this number also had pellagra two had typhoid another with a heavy estivo autumnal infection had a headache and only two were ill enough to go to bed with malaria as their only complaint The remainder had either no serious symptoms or chills and fever not sufficient to prevent them from being up and around

In the Lake Chicot group taken early in September only one of the positive cases a small child was sick enough to be in bed One woman with chronic appendicitis also showed a heavy crescent infection

During the season of 1925 from April 1 to November 1 malaria slides submitted to us by local physicians practicing in the Greenwood neighborhood have been examined by thick films stained with Giemsa In all 99 slides of cases suspected of having malaria were examined Of these six or 6 1 per cent were positive

During the months of September and October 1925 routine examination of the blood of all patients at a local clinic at Greenwood has been made by a competent microscopist using thin films stained with Wright s stain In September two positive slides were found of 36 examined and in October one positive slide was found in 40 examined

In the course of the surveys an attempt was made to get information as to various factors which might influence the well being of the negro tenants and to this end a card was filled out at every home visited with details as to the condition of the people and of the house necessarily a rather vague classification depending largely on the personal equation of the inquirer the number of persons living in the house whether the house was screened whether mosquito nets were used the number of Anopheles mosquitoes found in each house the source of the water supply whether or not there was a kitchen garden a cow poultry or hogs As an index of general prosperity the possession of an automobile was also noted The results of this survey of economic factors [illegible] given in the table below

The preponderance of flowing artesian wells in this region should be remarked as the excellent water furnished by them may also provide

TABLE III

Summary of Factors Included in Economic Survey of Delta Plantations

Numbe of f milie vi it d			456
Co d tion of people—			
G d		67	
Med um		279	
P		78	
Un l lf ed		3	
			456
C d tio f h —			
Good		40	
M d m		335	
[illegible]		50	
Un la fi d		31	
			456
Ho s w th s me cr e		10[illegible]	
F m li [illegible] i g m s ito n t		18[illegible]	
F n li w th no mo qu to p tecti [illegible]		13	
H e ex mi ed f r An ph les—			
J	16 A ph l f und	21	
July	1 3 A phel fo nd	156	
Aug t	64 A ph l f und	26	
A ka a (A gu t)	7 An phel f und	54	
	30	7	
I l d f w t [illegible]ply—			
A t an w ll (fl wi g)		240	
F mp (hall v ll)		07	
Or n w ll		1	
S[illegible] ing		[illegible]	
Lak		6	
			456
Fa i t kit h n g d n		4 9	t of 456
F mili k pi g w		15	[illegible] f 340
F mil k ping p ult y		31 o	t f 40
Fam li k ping h gs		64	t of 340
Fam l ha g aut mobiles		[illegible]	t f 456

breeding places for Aropheles mosquitoes Dr C C Bass has had considerable experience with these flowing wells in his malaria campaign in Ruleville Sunflower County in 1918 and found that they constituted there the chief source of the town s mosquito supply

In the course of the survey an attempt was made to determine how much migration from place to place occurred among the negro population Inquiry as to this was made of 438 families The chart below shows the result

SUMMARY

In summarizing the results of this investigation certain factors which influence our find

TABLE IV

L than a year n pr ent dw lli g	65 o	1 5 pe cent
O two ye rs	94	1 4 per cent
Tw th e y	73 o	16 6 pe c nt
Th to f u ye	57	13 0 pe nt
F to fi e y ars	38	8 6 p c nt
[illegible] to ten y a	73 o	16 6 p r nt
[illegible] t y [illegible]	45 o	10 9 p r c nt
T t l	433	

Th ho t t tim oted was on month d th l g t g ding which there [illegible] n [illegible] rable doubt t 60 y a

Tw hu d d a d tw nty two o a littl m th n 0 p t had liv d in th l p e t dw lling le th n th ee yea

Th b i g of this migr t ry h bit on a y att mpt at am l rati of th mala ia itu tion by m an f q i in th py by a b tt ho i g program l b io s

TABLE I

Comparison of Malaria Parasite Rates in Mississippi Delta

Observe	Locality	Year	Sea cn	Typ of subj t	Numl xamined	P c nt p itiv
M yne	Scott Miss	1915	Feb March	Plantation negroes	1 184	41 55
Ba b	G eenwood Mi s	1925	April	Negro school	136	5 1
De a x and Haas	Lake Village Ark	1916	March April	Plantation negroe	430	16 0
Ba b	Lake Village Ark	19 5	Aug Sept	Plantation negroes	288	3 8
Ba	Bolivar County Miss	1916	Yea	Plantation n groes	31 459	?
B t	? Flore County Miss and Lake Village Ark.	19 5	Aug Sept	Plantation negroes	537	5 5

aminations were sick or who gave histories of recent illness either of malaria or some other ailment The prevalence of malaria in the non selected group gave the incidence of malaria in the general population and the findings in the second group gave the portion of the sick rate due directly to malaria

Of the non selected group 234 persons were examined on a plantation near Greenwood Miss and 288 on several plantations on the shore of Lake Chicot near Lake Village Ark These examinations were made during the latter part of August and the first week of September during the season of highest malaria prevalence The rate for the Greenwood plantation was 5 55 per cent while for the Lake Chicot group it was 3 8 per cent

These rates should be compared with the results of examinations made by Bass[3] and his co workers during 1916 1917 in Bolivar County Mississippi These examinations extending over a period of a year showed infection rates of 17 per cent for whites and 22 2 per cent for colored in a total population of 31 459 82 per cent of which was colored In some parts of the area surveyed the rate rose as high as 84 per cent of the population among certain small communities (Kimball Lake) (See Table I)

The Lake Chicot group should give an excellent idea of the changed conditions in this region with regard to malaria prevalence as in April and May 1916 Derivaux and Haas surveyed a number of plantations on the shores of Lake Chicot examining by the thick film method 430 persons 79 white and 351 colored, finding 16 04 per cent infection Our survey nearly 10 years later included the same plantations and in many cases the identical persons examined by Derivaux and Haas As stated above our survey showed a rate of 3 8 per cent as compared with theirs of 16 04 per cent (See Table I)

Of the selected group a population of 1 953 was involved in the survey of which 612 or 31 3 per cent gave sufficient history or indication of illness to be examined for malaria parasites One hundred and one proved po itive for

TABLE II

Selected Group Greenwood Miss and Vicinity

19 Month	Number h m s visited	Population	Number d ml d to m laria ara it	Numb r positive	P rc ntag po itive	E A	B	C
June	17	95	23	4	17 4	3	1	
July	221	1 151	376	67	17 8	50	16	1
Augu t	147	707	213	30	14 1	[illegible]	8	
	385	1 953	612	101	16 5	75	25	1

tion from which these slides were taken does not report a high malaria rate. On another plantation in one of the highest malarial sections four out of 20 blood smears were found positive.

It may be interesting to note here that a comparison was made in the Mississippi Delta between two counties, one of which has conducted malaria control work for the past four years and the other was surveyed this year with a view of establishing malaria control in 1926.

The two Chambers of Commerce were written requesting information relative to the percentage of cotton crop that had been gathered up to the month of October and requesting information as to the reason for the amount so far taken out of the fields.

In the county in which malaria control has been in force for the past four years the Secretary of the Chamber of Commerce reported that up to 75 per cent of the crop had been gathered and attributed this early gathering to three factors:

(1) Excellent health of labor.
(2) Excellent weather.
(3) Early opening of entire crop.

The Secretary of the other Chamber of Commerce reported the crop to be about 45 per cent gathered, giving the reason that the shortage of labor had proved a great handicap and also stated that the malaria situation had interfered very little with cotton picking according to information received from the planters themselves and from the County Agent who was in close touch with the situation.

The true malaria condition of this latter county was definitely known by the State Board of Health and the secretary of the Chamber of Commerce was given the information with the result that the economic value of malaria control was realized and the matter placed before the Board of Directors for consideration. The State Board of Health asked what kind of cooperation was necessary and what financial aid the Chamber of Commerce could render in the efforts being made to stamp out malaria.

In this discussion facts showing the darker side of Mississippi's malaria prevalence have been given in an attempt to bring out the handicap which the presence of malaria fever is to the program of the Mississippi Delta.

However, the morbidity rate has dropped in the Delta Section from 13,303 per 100,000 to 8,223 since 1920 to 1924, and for a like period the mortality rate has dropped from 100.4 per 100,000 to 43.8.

The economic importance of controlling malaria is fully realized in Mississippi and forms the foundation of the plan to control this disease.

Dr. W. S. Leathers, Nashville, Tenn.—I was very much interested in the statistical data presented by the paper of Dr. Barber and Mr. Komp indicating clearly that there has been a measurable reduction in malaria incidence in the Mississippi Delta during the past ten years.

During the demonstration for the control of malaria conducted under the auspices of the Mississippi State Board of Health in cooperation with the International Health Board and under the scientific direction of Dr. Bass, it was rather exceptional to find cases of hematuria. Judging from this observation together with other information available the malignant types of malaria are not nearly so common at the present time in the Mississippi Delta as formerly, which is also an indication that the disease is occurring in milder form than heretofore. This is one of the signs of the disappearance of a disease which has shown serious proportions in relation to the public health. It is also true that the mortality statistics as recorded in Mississippi indicate unmistakably that malaria is disappearing with encouraging rapidity. In 1920 the total death rate for Mississippi per 100,000 population was 40.3, while in 1924 it was 20.4. The total death rate among the whites was not so high as that among the colored race, being 23.3 in 1920 and in 1924 11.8. The total death rate among negroes in 1920 was 55.8, while in 1924 it was 28. In 1916 the maximum number of cases of malaria reported to the State Department of Health was 159,000, these reports being made by approximately 00 per cent of the doctors of the State. In 1924 the number of cases of malaria had decreased to 79,600. The white population of the state showed a decline of malaria incidence of from 76,000 in 1916 to 41,000 in 1924. When it is known that in 1916 there were 1,492 deaths from this disease and 365 in 1924, it is obvious that the facts which have been presented in the paper which has just been read are reenforced.

There has been no greater achievement in this country during the past twenty-five years in public health work than the success which has been attained in the control of malaria. There are unquestionably a number of factors involved in this result, such as relative precipitation and improvements in economic conditions, but it is well to emphasize and continue to stress the important fact that the various official and voluntary health agencies of the United States have been active in carrying on a definite and aggressive campaign against this disease, and it is therefore reasonable to suppose that the most important factor in the reduction of malaria has been the efforts of the national, state and local departments of health, including the operations of the International Health Board. With continued improvement in the economic conditions of the citizenship of those areas in which malaria is prevalent and with more emphasis upon improved agricultural conditions by drainage, particularly sub-soil drainage, unquestionably there will be a continuous decrease in the incidence of malaria. There is no reason why the disease cannot be largely eradicated from the Southern States during the next fifteen or twenty years.

STUDIES ON BIRD MALARIA*†

By Robert W. Hegner, PhD,
Baltimore, Md.

(1) *Biological Studies of the Course of Infections in Canaries.*—Ever since the organization of the School of Hygiene and Public Health in 1918 work has been going on in the Department of Medical Zoology on bird

*From the School of Hygiene and Public Health, Johns Hopkins University.

†Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Nineteenth Annual Meeting, Dallas, Tex., Nov. 9-12, 1925.

ings should be mentioned The years 1924 and 1925 were years of subnormal precipitation during the malaria season which doubtless affected the anopheline population, and through it the prevalence of malaria Dr R D Dedwylder, County Health Officer of Bolivar County, Mississippi who has had wide experience in malaria work thinks that the subnormal precipitation for the past five years has been the largest factor in causing the reduction he has noted in rural malaria in Bolivar County

Improved economic conditions during the last few years due to larger crops and better prices is another factor which must enter into the situation The negro migration to the North leaving fewer laborers to produce the cotton crop may have tended to increase the labor income of the negro tenant Surely the fact that over 12 per cent of the families surveyed possessed automobiles is of significance especially in view of the fact that our census was taken during the lean' months that is long after the tenants had realized on their 1924 crop

The universal testimony of the practicing physicians of the Delta region that there has been a great decrease in malaria prevalence during the last 10 years is also substantiated on comparison of the results of our surveys with those obtained by competent investigators 10 years ago in the same territory We do not pretend to account for this decrease as the main purpose of this paper is to present the facts obtained by our surveys and to get them on record as a basis for further work

REFERENCES

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DISCUSSION (Abstract)

Dr F J Underwood Jackson Miss—The calculated economic loss in the state of Mississippi from malarial fever during the year 1924 was $?,355 775

As this discussion pertains generally to the Mississippi Delta region the proportion of this economic loss charged against this section of the state which embraces 14 counties and 8 284 square miles and 25 4 per cent of the state s population is given as $1 137 425 or approximately 50 per cent of the whole

In the remaining 68 counties of the state there are 38 078 square miles and 74 6 per cent of the population

The Delta Section of the State of Mississippi is commonly known to embrace the territory lying between the Mississippi River and the chain of hills extending from the Tennessee line south of Memphis southwest to Vicksburg

The alluvial territory is flat being protected from the high waters of the Mississippi River by levees The natural drainage outlet of this vast territory is through the Yazoo River which enters the Mississippi River at Vicksburg When the Mississippi River is at flood stage the drainage in this entire territory is seriously impaired As a protection to property numerous drainage districts have been established and levees built along the banks of inland rivers and their tributaries Spring floods are common in this section

Malaria control is considered to be one of the extensive development projects in the State of Mississippi

I am pleased to say that the Mississippi State Board of Development places first upon their program of furthering the progress of Mississippi the control of preventable diseases and fully realizes the handicap which malaria presents to the progress of the Delta region Active cooperation has been received from this Board and their future plans include the working hand in hand with the Mississippi State Board of Health to develop the man power of the state to as near 100 per cent efficiency as possible

During the last few years the plan to control malaria has been definitely extended to include county wide projects

Some interesting data was obtained this year relative to the economic bearing of malarial fever in the Mississippi Delta with reference to their abundant cotton crop and some of the information gathered follow

In one of our delta counties a study of fifteen plantations showed that there was a labor turnover of 36 per cent Malaria rates were gathered by taking histories which revealed that on these fifteen plantations there was a malaria rate in 1924 by homes of 29 2 per cent and by persons of 9 2 per cent

Segregating these plantations and collecting 1925 data we find that during the first half of the month of September there were approximately 50 cases out of 225 workers each case averaging two days loss from work

On another plantation it was found that 26 workers out of 74 had malaria this year the majority during the latter part of August and the first part of September

In another section of the county there were approximately 25 cases out of 400 workers In additional territory there were 82 cases out of 1 100 workers scattered over an area of 10 square miles On another plantation there were 15 cases out of 25 families

In the territory above referred to malaria came to a peak in August and decreased only slightly during September During the whole summer and up to September 24 the weather was fair with no rain It may be said that September was ideal for picking cotton up to the twenty fourth An inquiry showed that during this important picking time malaria was at its peak and caused serious inconvenience in gathering the crops Blood smears were taken from a group of apparently healthy normal school students during August Out of 52 specimens five were found to be positive These subjects were from all parts of the Delta

Of 33 slides taken on September 9 on one of the plantations five were found to be positive The sec

again reaches normal and often advances beyond the usual number The fall in the number of parasites in the peripheral blood is as rapid as the rise The factors responsible for this fall in numbers are not known but data presented below have a bearing on the subject After the fall in numbers parasites are still present in the peripheral blood apparently throughout the life of most birds although in very small numbers

The first attempt to study periodicity in bird malaria statistically was made by Mrs Taliaferro in Baltimore and later at the University of Chicago She made blood films at four hour intervals for periods of several days during various stages of the infection The mean size of the asexual stages of the parasites was determined from this material at different times of the day and the data obtained treated by statistical methods It was found that there is a definite periodicity in bird malaria and that this periodicity exists at every stage of the infection during the chronic period after the number of parasites has decreased to such an extent that very few are present in the blood as well as during the acute period Furthermore the fact was established that the period for the asexual cycle in the Baltimore strain obtained in 1924 was 24 hours in length and that each stage in the asexual cycle appeared at a particular hour of the day For example fully grown schizonts appeared at 1 00 p m many dividing schizonts at 5 00 p m and small merozoites at 9 00 p m When this strain was studied at Chicago these various stages were noted one hour later due to the change from Eastern standard to Central time As in all malarial infections some of the parasites were more advanced than others and some lagging forms were present but the majority maintained a precise periodicity The New York strain that had been continued by subinoculation in canaries for 11 years likewise exhibited periodicity but in this case the total asexual cycle occupied 30 instead of 24 hours Whether this difference is due to a genetical difference in the parasites or a change due to the long continued asexual multiplication without the intervention of sexual stages is not known The fact of periodicity proves that there is no change in the rate of multiplication of the parasites during the course of the infection and indicates that we must look elsewhere for an explanation of the rise and fall in the number of parasites Dr Drensky has been able to confirm Dr Taliaferro s results on periodicity with the Baltimore strain

The internal organs most profoundly concerned in a malarial infection are the spleen and bone marrow The spleen according to Boyd begins to enlarge as soon as parasites appear in the blood and reaches from 8 to 10 times its normal size at the peak of the infection being often very dark and hard As the infection subsides it decreases in size but seldom regains its normal dimensions and color Studies were made by Ben Harel and Feemster of the spleen and bone marrow by means of smears and sections during various stages of the infection These studies prove that the number of parasites in these organs just after the fall in numbers in the peripheral blood is not sufficient to account for this decrease Apparently most of the parasites are destroyed by some type of host resistance and are not stored up in the tissues Normal asexual stages of the parasite were found in these organs in four birds during the latent period two weeks one month 2½ months and 6 months after the fall in parasite numbers in the blood This proves that asexual reproduction takes place during the latent period Since Dr Taliaferro has shown that the rate of reproduction is maintained during this period the failure of the parasites to increase in the blood must be due to some type of host resistance which kills off most of the parasites as soon as they are produced It follows that the lowering of this resistance would allow more of the parasites to develop and if the resistance were reduced sufficiently over a long enough period of time would result in relapse

Experimental studies of the course of infections with bird malaria were carried out by Dr Boyd The influence of variations in the number of parasites inoculated was first investigated Five birds each inoculated with 100 parasites did not become infected Later they were infected with large doses which shows that no lasting immunity ensues when too few parasites are inoculated to bring about an infection Of seven birds inoculated with 1 000 two became infected and five did not Five of six birds inoculated with 10 000 became infected The detailed data from these experiments show that a high correlation exists between the size of the dose and the length of the incubation period The latter decreases as the dose is increased A less pronounced positive correlation is evident between the size of the dose and the height of the peak and there is no correlation between the number of parasites inoculated and the length of the period of rise

malaria Those who have taken part are in chronological order Dr E R Whitmore Dr S Ben Harel Dr G H Boyd Dr L G Taliaferro Dr K S Drensky Dr R F Feemster Dr C F Scudder, Dr E H Shaw and Mr E Hartman The organisms used in our investigations consist of two strains one was obtained by Dr Whitmore from sparrows in New York in 1913 and the other by Mr Hartman from sparrows in Baltimore in 1924 The experimental animals used have been canary birds *Serinus canarius* Our studies may be separated into two types (1) biological and (2) therapeutic Experiments on therapeutics have involved free living protozoa as well as the malarial organism

Canary birds and their malarial organisms of the species *Plasmodium precox* are of peculiar value as material for the study of certain problems in malaria In the first place it is worthy of note that the sexual phenomena in the life cycle of the malarial parasite of man was discovered by McCallum only after he had observed the process in a related organism in birds Furthermore the discovery of the transmission of malaria from one vertebrate host to another was first made by Ross on bird malaria and later confirmed by Grassi and others for human malaria The organisms of both bird malaria and human malaria are similar as regards the stages in the life cycle morphological characteristics and clinical effects on the host and in both the response to quinin treatment is such that complete sterilization often fails Canary birds are easily obtained at a reasonable cost and can be kept in large numbers in the laboratory Infections are easily made by the inoculation of blood from an infected bird into the breast muscles or peritoneal cavity of a clean bird The course of these infections in birds resembles very closely that of human malaria and the results obtained from their investigation can be translated more or less directly into terms of human malaria It is possible moreover to carry out experiments on birds that cannot be performed on human beings and thus the way is opened up for study of problems that cannot be attacked in human malaria

All of our work has a bearing on the problem of relapse which I believe to be the most important problem in malaria at the present time Dr Ben Harel studied the localization of the parasites in the internal organs at various intervals after the subsidence of the acute infection Dr Whitmore carried on experiments on the action of light on relapse, Dr Taliaferro s work on the resistance of hosts to the multiplication of blood inhabiting parasites has a bearing on this subject and our studies on therapeutics are directed particularly toward the discovery of an agent that will actually rid the body of all malarial parasites If the last named project is successful the eradication of malaria in certain regions will be very simple since mosquitoes do not carry the organism through the winter and can only become infected in the spring by biting human beings who are suffering from a relapse of an infection of the previous year that was not entirely cleared up

Before experimental work could be done the natural course of the infection of birds with *Plasmodium precox* was worked out This involved both studies of the infection as revealed in the peripheral blood and in the internal organs Whitmore found that blood from a bird that had been infected was capable of setting up an infection in a clean bird many months after parasites could be found in the blood by ordinary examination This proved that parasites remained in the blood of an infected bird in small numbers for a considerable period in one case for twenty nine months (until the death of the bird) and usually probably throughout the life of the bird

The course of the infection in birds has been studied carefully by Ben Harel and Boyd After infected blood has been injected into the breast muscles of a clean bird a period of incubation ensues lasting from 3 to 11 days the average length of time being 5 33 days During this period of incubation and before parasites appear in the blood the number of red cells decreases For example Ben Harel noted in one bird a decrease from 4 785 000 per cmm to 4 000 000 and in another bird a decrease from 5 000 000 to 4 150 000 The period of incubation is followed by a period of rise in parasite number which lasts from 2 to 10 days with an average of 5 33 days The number of parasites increases rapidly until the peak is reached At this point there may be from 10 to 5 000 parasites per 10 000 red cells No reason is known for this great variation but work on this point is now in progress A continued decrease in red blood cells occurs during this period often reaching 50 per cent of the normal number The blood forming organs, however are stimulated to hyperactivity and many young cells appear in the blood and soon after the acute attack has subsided the number of red cells

were therefore used for further work A single dose with derivatives C74 C72 and C120 (one half of the minimum lethal dose) given one hour before inoculation with 5 000 000 parasites failed to prevent infection due presumably to the rapid excretion of the drug A single dose at an early stage of the infection with quinin hydrochlorid and derivatives C74 and C161 gave a slight retardation in the rise of the infection Repeated doses given orally three doses daily at six hour intervals of one fourth the minimum lethal dose or six doses daily at two hour intervals with quinin hydrochlorid C74 C72 C120 and C161 showed quinin hydrochlorid to be very efficient against the parasites in which respect it resembles the effect on human malaria and to be more efficient than the other drugs used in the experiments Daily doses for two weeks during the period of chronic infection did not free the birds from parasites Parasites were present both during and after treatment

The conclusion to be derived from these studies is that quinin hydrochlorid is more effective than any of the other drugs used Considerable further progress with drugs has been made but cannot be reported at the present time

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OBSERVATIONS ON THE TREATMENT OF MALARIA WITH STOVARSOL*†

By C C BASS M D
New Orleans La

Stovarsol (Acetylaminohydroxyphenylarsonic acid) is a synthetic arsenical designed by Levaditi and his co workers[1] to be administered by mouth and intended at first for use in the treatment of syphilis It has also been found to be useful in the treatment of amebic dysentery Its amebacidal properties first noted by Levaditi and his co workers have been confirmed by numerous observers particularly in France by Garin and Lepine and in this country by Johns and Jamison[3,4] The fact that this drug has amebacidal properties against the intestinal ameba of amebic dysentery naturally has suggested that it might also have similar properties against the hemameba of malaria a somewhat similar protozoan parasite

The first published report of the treatment of malaria with stovarsol was by Valenti and Tomaselli[5] who treated two cases They reported brilliant results in one case of quartan and one of tertian malaria In the quartan case they state that intensive and continued quinin medication proved ineffective Two attacks were allowed to occur under observation before the treatment with stovarsol was begun One tablet (0 25 gm) was given on the first day and two tablets on each of the following ten days One more attack occurred after which the patient remained afebrile and parasites disappeared finally after the sixth day In the tertian case the patient who had remained afebrile under observation for twenty days developed severe clinical attacks with tertian parasites in the blood After three such attacks he was put on stovarsol one tablet the first day two during each of the following three days and one the next making a total of five days of treatment One mild attack occurred after the stovarsol treatment was begun but no more and the parasites quickly disappeared The enlarged spleen decreased in size rapidly in both cases

Marchoux[6] administered stovarsol in 1 gm doses orally subcutaneously intramuscularly or intravenously to 44 persons with malaria 19 quartan 13 estivo autumnal and 12 tertian In all the tertian cases the parasites and symptoms rapidly disappeared The other forms were unaffected Marchoux and Cohen[7] gave stovarsol intravenously to seven general paralytics who had been inoculated with benign tertian malaria The mature schizonts and gametocytes disappeared in four to six hours and all forms within twenty four hours

At the time I offered to present a paper on this subject I intended to treat a number of well selected cases with stovarsol and hoped to have sufficient personal observations to be of use in indicating the value of the drug in

*F m th Dep tment of M di ine T lan U i ve ity School of M di in N w O leans

†P d b f re Natio al Mala ia Committee (C nf r e on M l ria) m ti g co j intly with South n M dic l Asso i ti n Ninet nth An l Meeti g Dall s T ov 9 1 1925

To determine comparative numbers of parasite in the blood serum, whole blood washed red cells and serum from infected birds were inoculated into clean birds Ten birds were used for each type of experiment Differences were noted in the number of birds that became infected in the length of the incubation period and in the number of parasites All birds inoculated with whole blood and washed cell were positive whereas only 4 of 10 inoculated with serum became infected The incubation period rose from three days in birds inoculated with whole blood to 3 6 in those inoculated with washed red cells and to 7 75 in those inoculated with serum The average number of parasites per 10 000 red cells was for the whole blood series 1 348 for the washed red cell series 765 and for the serum series 352 These results prove that during a normal infection the number of parasites free in the serum is very small except of course, at the time of merozoite formation and that there is probably no ultramicroscopic stage in the life cycle of the parasite in the peripheral blood during the acute period of infection

The virulence of the parasites during the various stages of an infection was studied by inoculating fresh birds with blood taken from infected birds during (1) the first and second days of an infection (2) the third and fourth days (3) the fifth and sixth days and (4) the chronic period The results of experiments on 50 birds are not conclusive but indicate that the virulence is greatest from two to four days after the parasites appear in the blood and is lowest after the parasites are subjected to the host for some time Virulence in these experiments was measured by the ability of the parasites to invade a new host and by the severity of the infection produced Virulence was also tested in two series of 16 and 8 birds respectively by rapid passage fresh birds being inoculated on the third day of the infection No great increase in virulence was obtained and only three transfers were necessary to secure a fixed virus An increase in virulence to the lethal point does not seem possible

Among the factors that bring about relapse in malaria are ultra violet rays Whitmore has made a beginning in a study of the exact relation of these rays as well as of x rays to relapse Data thus far obtained are not conclusive but preliminary studies indicate promising results later

(2) *Therapeutic Action of Quinin Hydrochlorid and Certain Quinin Derivatives in Experimental Infections with Plasmodium Precox* —The quinin salts now in general use for the treatment of malaria are recognized as effective agents for the treatment of a malarial attack but as ineffective in ridding the host of all of the parasites A few parasites remain in the body apparently passing through the regular asexual cycle Such hosts are carriers from whom mosquitoes may acquire an infection and are subject to relapses thus becoming a menace to the community It has been shown that bird malaria responds to treatment with quinin salts in a way similar to human malaria Birds may, therefore be considered favorable material for therapeutic studies Dr Boyd Dr Shaw and Mr Hartman have been engaged in this laboratory in an endeavor to determine whether certain quinin derivatives may not be more effective than quinin in ridding the host of parasites Synthetic quinin derivatives were kindly supplied by Dr Walter A Jacobs of the Rockefeller Institute for Medical Research and quinin hydrochlorid was used as a control The salts were dissolved in normal saline solution and given both by intramuscular injection and orally The toxic action of the drugs on the host was first determined It was found that the birds either die or recover in a short time after the injection of the drugs the symptoms being violent gastric disturbance muscular weakness and loss of coordination Examples of the minimum lethal dose and the hemolytic effect on red cells *in vitro* are as follows

Quinin hydrochlorid	intramuscular 4 mg	per os 8 mg	hemolysis partial
Derivative C 74	3 5 mg	per os 5 mg	hemolysis slight
Derivative C 72	1 mg	per os 1 5 mg	hemolysis complete
Derivative C161	3 5 mg	per os 5 mg	hemolysis partial

The effects on the parasite *in vitro* were studied next in order to obtain a clue as to which drugs might be expected to be most effective when injected into infected birds The drugs were dissolved in normal saline then added to infected blood and incubated at 39 C for 20 minutes The cells were then washed thoroughly and inoculated into clean birds Infections were obtained with five quinin derivatives and two controls the period of incubation being much extended in the case of the derivatives No infections were obtained with quinin hydrochlorid and three of the quinin derivatives C74 C72 and C120 The latter

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DISCUSSION (Abstract)

Dr William Krau ss M mphis Tenn—Dr Bass ex perience with stovarsol is ju t what I had e pected it to be Th s dru came into sudden prominence for the cure of amebias s In full doses it may be toxic One of our staff just s ved a dysentery pat ent by the prompt intravenous inject on of sod um th osul phate It will be remembered that in 1072 at the Rudolph Virchow Hosp tal arsphenamin had proved fatal to several patients It was found that these pat ents under treatme t for syphil s had estivo autum nal malaria The fatal results wer a cr bed to the eff ct of the drug in heavy infection with estivo autumnal malar a The consen us of opinion the world o er i that arsphenamin is curative of tertian but p ovocative of est vo autumnal malaria This is a gued ■ proof of the specific difference of the two para sit s We th nk ar phenamin is useful after quin n has been ■ en Used in this way on about 150 pa tients last year we had for the fir t time ne ther d aths nor known relapses Stovarsol can be given by mouth and may p ove to be useful for after treatment of malaria

I recall the history of a case of syph l s with co i cide t m laria The pat ent had a chill just as we were prep ring to inje t him w th the original ars phenamin at the time of its introduction There were numerous ■ a r ngs We feared to give qu nin and the new drug together and so we injected him the next day taki g chances that the inject on might help the malaria He had a nasty ■ action a d on the next day he had a hard chill Parasites were numerous I am afra d of arsenical in untre ted malaria

D Enriq e Ma tine Carr a Monte ey N L Me co—Mercuroch ome in the treatment of malaria does not give the results that ha e been ad ertised on account of its reaction We tr ed ■ on several pa tie ts in the Mil tary Hosp tal of Monterrey and we did not reli ve the pat ents of the malaria infection unl ■ we used qu n n in some form with it My be lief it that when a patient does not ■ pond to qu n n rally or ntraven usly in three or four days he has some other i fection that ■ non malarial I have used mercur chrome intravenously with good results in typhoid infections typhus and some chronic gonor rh l infect ons I am af a d to use it n private prac tic n mal ria beca se mal r can be controlled with qui in and we a e not justif ed in having the patie t undergo th s reacti n when the ■ are other l ss dan g o s methods f obta ng the same results

AN EXPERIENCE WITH INTENSIVE QUININ TREATMENT UNDER FIELD CONDITIONS*

By R K Collins M D
International Health Board
Leesburg Ga

During the years 1924 and 1925 an experi ment was carried on in Terrell County Geor gia for the purpose of observing the value of quinin in the treatment of chronic malaria Because there has always been considerable discussion as to the practicability of quinin therapy as a general public health measure it was felt that such an experiment as is here de scribed might be of some value The work was initiated in 1924 under the direction of Dr S T Darling and completed in 1925 under the direction of Dr Mark F Boyd

The locality chosen for the experiment is one of high malaria endemicity The population elected was wholly rural and consisted of negro children between the ages of two and twelve years The population is shifting in character ina much as there ■ an extensive migration of the negro families from one plantation to another between the harvest sea on and the next planting season Very few of the negroes are landowners Most of them rent land or raise crops on shares For this reason it was impossible to make continuous observations on a selected group over two seasons Instead the experiment was divided into two sections one conducted in 1924 the other in 1925

The first study included a group of seventy four children with spleens varying in size from those just palpable on deep inspiration to those extending below the costal margin to the umbili cus Of these children twenty eight were used as controls and forty six were treated Every effort was made to have equal numbers of each spleen size in both groups and to have controls and treated cases in the same households In this way the factors of nutrition exposure to reinfection etc were equalized in so far as possible For the second part of the experiment carried out in 1925 sixty nine children were chosen Of these fifteen were used as con trol and fifty four were given treatment Pre-cautions were taken to obtain distribution of cases as was done in 1924

The method of treatment was based on the

*R ad bef the Natl al M la i C mmittee (Con f c n Mal ia) m ting onjointly with South rn M dical A sociation Ni te th A n al Meeting Dall T x N v 9 1 19 5

malaria Certain circumstances have limited the number of cases observed to two The circumstances referred to particularly are the scarcity of suitable available malaria cases and receipt of information which leads to doubt as to the safety of the use of stovarsol on account of possible toxic reactions

The number of cases of malaria seen in New Orleans has been rapidly decreasing for some time Those that are seen receive their infection somewhere else and most of the cases are non residents For this reason we have not had at our disposal sufficient suitable cases for study It would seem that the opportunity for the study of malaria on large numbers of cases in New Orleans is passed

In malaria it frequently occurs that when patients are put to bed on light diet and hospital regimen the clinical symptoms rapidly improve or disappear The number of parasites gradually lessens and they also finally disappear For the results of a treatment being tested to be significant, the conditions must be such as to favor continuation of the disease and not improvement These conditions which favor improvement and tend to bring about recovery when patients are hospitalized might be responsible for such improvement as occurs and not the drug used

One of our cases was ideal for the purpose There was no evidence of any effect of the stovarsol in this case This patient had been havin somewhat irregularly occurring paroxysms during a period of about three months with occasional intervals of several days during which he had no attacks probably due to the treatment that he took at these times His blood showed numerous quartan parasites both gametocytes and schizonts includ ng a good many rosettes He was put on stovarsol one tablet three times daily and instructed to conti ue his u ual activities and to eat anything and all that he wanted The object was to allow the malaria to continue except for such effect as the tovarsol might have The treatment was continued for four full days during which his temperature at the time he returned for observation each day was 99 6 before treatment 101 4 103 6 102 4 103 3 There was no demonstrable reduction in the number of parasites or recognized changes in them and the patient was quite ill On the fifth day he was put on ten grains quinin sulphate three times daily When next seen about twenty four hours after the quinin was started his temperature was 99 4 and after prolonged search of several blood specimens one parasite was found The next day his temperature was 98 4 and no parasites could be found

The symptoms continued unabated and parasites were not reduced by stovarsol treatment for four full days Both symptoms and parasites were practically controlled in twenty four hours and completely o in forty eight hours by treatment with qu nin There was no evidence discovered that the stovarsol had any effect whatever in this case

The other ca e was one of tertian malaria due to *Plasmodium vivax* The patient had been having chills and fever but had taken a few small doses of quinin when he came under observation He had improved somewhat but still had fever and some parasites He was kept under observation for four days during which time he had fever and para ites at the time of ob ervation each day He was put on stovarsol one tablet three times daily and kept under observation The next day about twenty four hours after starting the stovarsol his temperature was 99 2 and it was extremely difficult to find any parasites The next day temperature was 98 3 and no parasites could be found He remained free from symptoms and parasites for five days when he was lost sight of

It seems in this case of tertian malaria stovarsol caused fairly prompt disappearance of parasites and symptoms Mention should be made of the fact however that his temperature had tended to run lower and his parasites to become less numerous before the stovarsol treatment was started In fact we debated whether it should be started at the time feeling apprehensive that the symptoms were about to stop and that spontaneous improvement was occurring Many cases do improve and the symptoms and parasites disappear without any treatment whatever I fear that the case was not well chosen and that the apparent results may be misleading However there is a possibility and I believe we can say strong probability that the clinical symptoms and parasites were influenced favorably by the stovarsol

From our observation on these two cases treated with full doses of stovarsol we did not find any evidence that it has any effect whatever on the symptoms or parasites in quartan malaria On the other hand benign tertian symptoms and parasites disappeared while a patient was under treatment with stovarsol and this may have resulted from the treatment given Stovarsol in this case of tertian malaria and in other published cases seems to have an effect equal to but by no means superior to that of quinin in controlling the active symptoms and the parasites It will be interesting to learn from further observations how it may compare with quinin in curing the infection

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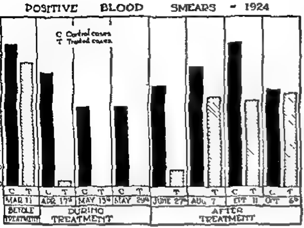
CHART I



from each child a hemoglobin reading was made and the spleen was palpated Blood films were stained with Hasting s stain and examined for twenty minutes before being designated as negative Hemoglobin estimations were made with the Dare instrument and always by the same individual thus eliminating error as much as possible For purposes of comparison arbitrary weights have been given to the various spleen sizes based on Bean s measurements of children These are as follows

	Grams
Negative	75
Palpable on inspiration	90
Palpable	105
Palpable 1 finger s breadth below costal margin	125
Palpable 2 finger s breadth below costal margin	150
Palpable 3 finger s breadth below costal margin	180
Palpable to umbilicus	220

In the 1924 experiment the treatment was begun on March 11 and discontinued on May 29 The last examination was made on October 16 The tabulated data for the experiment follow

Of particular interest is the fact illustrated by Chart 1 that the dosage of quinin was sufficient to clear the peripheral blood stream of parasites and to maintain this state as long as the drug was used However on the termination of treatment parasites at once reappeared in the peripheral blood stream and within three months almost reached pre treatment level The fall in the blood index of the control group during the spring and before the onset of the malaria season is noteworthy With the appearance of increasing numbers of *Anopheles quadrimaculatus* there was a uniform rise in the blood index of both groups

Chart II shows that the reduction in the spleen mass under treatment was quite distinct, but that as soon as treatment was stopped it exhibited a marked tendency to increase in size The pre treatment level of enlargement however was not reached within the period of observation

CHART II

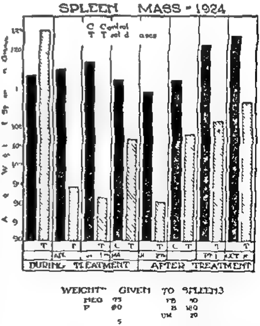


TABLE I—RESULTS OF MALARIA STUDIES IN 19[illegible] SEVENTY FOUR CASES

Date of Examination	Per Cent of positive blood: Controls	Treated	Average spleen weight (estimated): Control	Treated	Average Per Cent hemoglobin: Controls	Treated
March 11	78	66	116 0	1 3 0	82 9	81 6
April 1	61	5	117 0	98 4	79 9	83 3
May 13	[illegible]	0	118 2	96 2	77 6	81 6
May 29	42	0	115	94 2	76 4	80 0
June [illegible]	54	9	113	96	6 7	78 9
August 7	64	48	118 2	106 6	76 6	75 7
September 22	77	46	1 0 6	108 8	4 2	77 3
October 16	[illegible]	50	1 2 4	111 4	69 9	70 4

[illegible] treated [illegible] controls.

so called Bass or standard treatment recommended by the National Malaria Committee. The quinin used was Powers Weightman Rosengarten's quinin sulphate taken from the original containers. It was administered in syrup of yerba santa. Two suspensions were made under the direct supervision of a physician from the station who personally checked all weighing and measuring operations. One suspension contained four grains of quinin to the dram and the other six grains to the dram. With this combination any dose given in the table below could be accurately measured. A gallon of each syrup was sufficient to last about two weeks. To prevent souring no more than this small quantity was made at one time. The syrup was thoroughly shaken before the administration of each dose. The dispenser had a roll book in which he kept a record of every dose for each child. He visited each child every day and with his own hand measured and administered the doses. Only in this way could there be absolute assurance that every child ingested his daily dose. The doses used were as follows

Age of Child	Dose of Quinin
2 years	2 grains
3 to 4 years	3 grains
5 to 7 years	4 grains
8 to 10 years	6 grains
11 to 14 years	8 grains

In the 1924 experiment the treated cases were given quinin for ten weeks. In 1925 treatment was continued for twelve weeks. In the latter year the matter of reduced dosage was given consideration and the treatment group was divided. In one section there were twenty five children who were given the customary daily dosage. In the second section of twenty eight children the regular dose was given on alternate days so that the total amount of quinin administered was one half that received by the children treated daily.

Before passing to a consideration of the data furnished by the experiment it is necessary to describe the general conditions under which the two phases of the experiment were carried on, how these differed in the two years, and the effect of these differences on the results of the study.

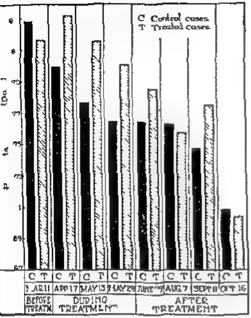
The year 1924 was slightly subnormal in respect to precipitation. It was not considered to be normally severe so far as malaria rates were concerned. However there was plentiful breeding of *Anopheles quadrimaculatus* and although there was doubtless a reduction in the amount of active malaria, there was still no paucity of febrile attacks. Only two cases of hemoglobinuric fever came to the attention of Dr Darling in 1924 while in the previous year there had been several. As a result of the relatively dry season excellent crops of cotton and peanuts were harvested by the negroes. As these crops are the two chief sources of revenue in this district, the good harvests were followed by a general improvement in the physical condition of the negroes. Better food supplies were generally available.

In January 1925 there was extremely heavy rainfall. The total fall within ten days was almost one third the normal yearly precipitation. However after the flood the rainfall suddenly declined and remained subnormal up to the time of writing (early October). This resulted in an unprecedented drought. Coincident with the drought nearly all the customary breeding places of anopheles in this area disappeared. By the time *Anopheles quadrimaculatus* would have begun to appear in considerable numbers in a normal year, in 1925 there were none or only an insignificant number to be found. Therefore transmission of malaria plasmodia was obviously reduced. This stroke of fortune combined with the factors for physical good before mentioned was manifested in a very marked reduction in the amount of active malaria. No cases of blackwater fever were seen in 1925. Among the children in the control group there was a tendency to a reduction of the splenic mass and a decline in the blood index. This factor is to be considered when evaluating the effect of quinin on the treated groups in the 1925 experiment. These cases show the combined results of no transmission and quinin therapy. For this reason they do not furnish as valuable a measure of the effects of quinin as do the cases treated in 1924, a year in which malaria transmission was far more prevalent and in which rainfall and mosquito breeding, though not normal, were more nearly so than in 1925.

The material for the two years will be recorded separately in the tabulation of data. In both years a preliminary examination of the children was made and treatment was thereupon begun and continued for the specified time. All children were re-examined at intervals of four weeks during treatment and for three or four months after its discontinuance or as long as conditions of crop harvests and movement of the population warranted. At these examinations a thin blood film was taken

CHART V

AVERAGE HAEMOGLOBIN



in the untreated cases. This acceleration is most obvious in the group given daily treatment.

Chart XI shows that in 1925 the hemoglobin of all cases, instead of exhibiting the uniform tendency to fall as was observed in 1924, remained practically constant throughout the entire period of observation. There was no significant difference between the course of the hemoglobin curves in the treated and the control cases.

Considering the differences between the two treated groups in 1925 we see a definite tendency to reduction of the parasites and of the spleen mass in the children given treatment on alternate days. However, the blood streams of this group were never cleared completely of plasmodia as occurred in the daily treated cases, nor were the spleens reduced as much as in the latter group. The reduction in parasites and spleen mass seems roughly proportional to the amount of quinin taken.

The spleen reduction in the daily treatment groups of the two years shows an interesting contrast: *in the 1924 group the spleens tended* to return to their pre-treatment status within two or three months after treatment was stopped, while in 1925 the reduction attained under treatment was maintained practically at a level after the cessation of treatment. The same contrast may be seen in the control groups as well: reduction in 1924 was slight in midsummer and the gain was lost in late summer, while in 1925 reduction continued throughout the period of observation.

In contrasting the differences of the two years the following brief summary is useful.

CONCLUSIONS

It seems reasonable on the basis of the experience gained in these two series of treatments to conclude that:

(1) In years when there is not more than an average amount of malaria transmission in an endemic region the standard treatment will eliminate parasites from the peripheral blood stream and prevent relapse during the period of treatment. It will also cause a marked reduction in the spleen mass. These conditions prevail only so long as treatment is continued.

(2) Upon discontinuing treatment the peripheral blood very rapidly becomes reinvaded by the parasites and the spleens increase in size.

(3) Very little is gained by treatment in a year when malaria transmission is naturally reduced, except a slight acceleration in the clearing of the blood stream and in the reduction of spleen size.

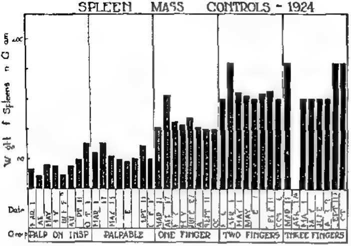
(4) Half the amount of quinin recommended by the standard treatment will not clear the

TABLE II.—RESULTS OF MALARIA STUDIES IN 1925. SIXTY-NINE CASES

Date of Examination	Per Cent of Positive Blood			Average Spleen Weights (Estimated)			Average Per Cent Hemoglobin		
	Controls	Treated		Controls	Treated		Controls	Treated	
		Alternate Day	Daily		Alternate Days	Daily		Alternate Days	Daily
February 9	53	44	6	106	112	117	77	76	75
March 13	7	4	0	124	99	105	77	79	77
April 10	46	7	0	110	97	99	76	[illegible]	76
May 7	60	11	0	109	94	[illegible]	79	76	77
June 4	13	4	0	104	9[illegible]	[illegible]	73	76	[illegible]
July [illegible]	36	7	4	100	9[illegible]	[illegible]	77	79	77
July 30	40	13	9	97	93	90	Not taken		

15 controls, 16 cases treated daily, 28 cases treated on alternate days.

CHART III



effect was not observed during the 1925 experiment

For the experiment carried on in 1925, the preliminary examination was made on February 9 Treatment was begun immediately and continued for twelve weeks i e, until May 7 Examinations were made at intervals of twenty eight days from February 9 to July 30 The data thus obtained are recorded in Table II

A point of great interest in the results of the 1925 experiment lies in the behavior of the control group In Chart VI showing the blood index we observe a decline in the level at the termination of the experiment In 1924 it is to be recalled the index of the control group rose through the late summer and fall The ability of the standard treatment to clear the peripheral blood stream of parasites is again well shown It is interesting to note that the reduced dosage failed to accomplish this result

In Chart VII we see that the average spleen weight of the 1925 control group shows a very marked tendency to decrease whereas in 1924 it exhibited an equally definite tendency to increase particularly in the late summer Chart VIII shows that in 1925 the reduction of the spleen mass occurred in all the spleen groups of the control cases and was most apparent after the March examination

Apparently the effect of quinin in the treated cases as shown by Charts IX and X is somewhat to hasten the process that is taking place

From Chart IV it will be seen that the spleens of larger size responded to the treatment far more markedly than those of smaller size but that all the spleens tended to return to their pretreatment degree of enlargement with the same rapidity

The general uniformity of spleen size in the control group throughout the period of observation is shown in Chart III It is to be noted however that a slight increase in size occurred after the onset of the transmission season

The figures secured on hemoglobins presented in Chart V are the least satisfying of the data obtained It will be seen that there was a fairly uniform fall in the hemoglobin of both groups during the period of the experiment The reduction was more gradual in the group of treated cases during treatment There are several factors to consider in this connection however (1) April and late March are the plowing season and children from nine years of age upward are subjected to the strenuous exertion of this operation (2) September and October are the harvest season for cotton and peanuts and the children are all in the fields at this time Perhaps no season subjects the children to such severe physical fatigue as does the peanut harvest (3) At times quinin seems to have the power of reducing the hemoglobin and this may in part explain the reduction which occurred in the treated cases As will be seen later however this

CHART IX

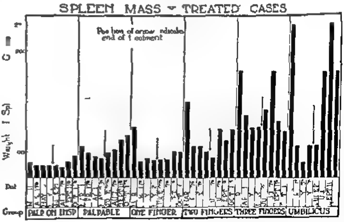
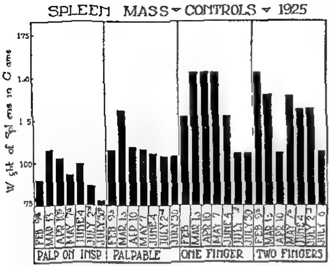


CHART VIII



The standard treatment given under constant supervision during the sixty day period and to a generally poorly nourished series of cases failed in 25 per cent of cases to rid the patients of parasites

The extravagant claims for the standard treatment offered too promiscuously by non medical health workers have tended to over popularize it making the treatment more an original package process of self medication rather than of sufficient importance to demand supervision and direction by the physician Every case of malaria infection should be considered serious enough to require treatment by a physician Feeding cure of concomitant hookworm disease and general care are almost as important in the treatment as quinization Of prime importance is the thorough teaching of malaria in all of its phases in the medical schools

Dr David H Kelly Pineville La—No community can afford to treat malaria and ignore the intensive use of quinin At the Central Louisiana State Hospital where Dr Thomas has been Superintendent for many years the necessity of quinin has diminished consistently but this we feel is due to the fact that we are handling the malaria problem from every standpoint Dr Thomas says that whereas he used to use pounds of quinin a year he now uses ounces At the same time the entire hospital plantation has been thoroughly ditched and large portions have been oiled. Many *of our buildings have been screened* and every proven case of malaria has been given the routine quinin treatment as prescribed by the State Board of Health

We have in this hospital a full time pathologist and every case of fever has an examination to determine the presence or absence of malaria parasites If the parasite is absent and the symptoms of malaria are present we treat them anyway

We have always in the hospital a certain number of cases of malaria among the recently admitted but each year we have fewer and fewer cases of malaria to report and it is my opinion that it is very largely due to the frequent and persistent use of quinin

Dr Wm Krauss Memphis Tenn—There are four objectives in giving quinin It is well to consider which is the most important in a given case We give quinin for prevention for the fever for eradication of gametes and to prevent relapse As to the first quinin in reasonable doses has not been satisfactory for the prevention of malaria Judging from the studies of Yorke and Macfie quinin taken immediately after exposure does not prevent malaria In our territory prophylactic quinin would be unjustifiable Gamete destruction and relapse prevention can be considered together Gametes will not survive if their production is stopped with large doses of quinin given continuously for a month but with the relapse they recur Just what per cent would relapse under such conditions?

Our studies in Memphis gave results quite parallel with those of Dr Collins We followed up a group of cases for the better part of a year but the number we were able to locate diminished to such an extent that we did not complete the sutdy Those who continued their quinin more or less regularly fared somewhat better than those who did not The difference was not very striking Their economic status seemed to play a more important role than their faith fulness in taking quinin The most we can say is that the more regularly the relapsing patients keep up their quinin the more days they will be able to be on their feet *In our follow up work we examined* the blood periodically We had to rely on the statement of the patient as to faithfulness in carrying out our treatment After all this is what you have to expect in practice You cannot force any considerable

CHART IX

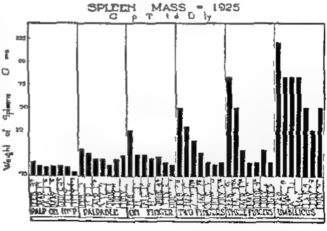
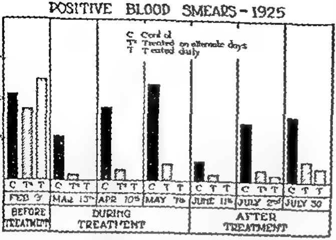


CHART VI



peripheral blood stream of plasmodia In general the larger dosage produces a greater reduction in the spleen size than the smaller doses

(5) In this experiment the hemoglobin estimation did not prove of practical value in determining improvement in children treated with quinin for chronic malaria

(6) The use of the standard treatment as recommended *is of definite benefit during its* administration but it has been shown insufficient to effect a cure in chronic cases To be effectively administered the method demands strict and expensive supervision Therefore the experiment would seem to indicate that the *standard treatment* cannot be recommended as a public health measure

DISCUSSION (Abstract)

Dr Roy K Flannagan Richmond Va—I am not prepared to challenge the scientific accuracy of data presented by Dr Collins. I do however wish to say in connection with his conclusion that this body should go on record as opposed to the standard quinin treatment for malaria that I hope that no positive action in line with his viewpoint will be taken by this body at this time After full consideration and if I mistake not on recommendation of the National Malaria Committee the Virginia State Board of Health has thoroughly advertised the value of the standard treatment. While we do not wish to put ourselves in the position of saying that we will not change a course when that course is found to be out of line with the best procedure there are serious obstacles in the way of our reversing our position in regard *to the standard* treatment at this time We have secured the *cooperation of physicians and laymen* in the more systematic use of quinin in malarious districts of Virginia, and if we threw any cloud on the standard treatment we would in large measure lose the confidence of those upon whom we must rely to help us carry out our malaria control program From an administrative standpoint at least such a course would be disastrous If we must back out let us do it after fuller consideration of all the facts Personally I am not as yet convinced that we should change our course at all

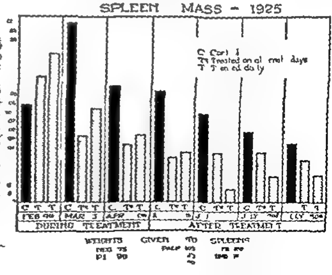
Dr John A Ferrell New York N Y—Observations along the lines of Dr Collins studies should be made by other *scientists under varying conditions* and reported. Evidence accumulated in this way will in the end guide administrators in the formulation of plans for control *measures*.

If Dr Collins could have scheduled the period of quinin administration so that it might have continued until frost the element of doubt that has been expressed relative to the possibility of unobserved quadrimaculatus reinfecting the persons being studied, would have been practically removed.

The National Malaria Committee should I think be quite conservative in adopting resolutions for or against a proposed method of malaria control The values and limitations of quinin should be *definitely* determined by qualified investigators and their work should be checked up by competent workers When *this is done and the conclusions are* published the procedures that stand the test will be adopted by official health organizations.

Dr T H D Griffitts U S P H S Montgomery Ala—The results in Georgia follow closely those we had in Alabama a year previously which were published in the Public Health Reports

CHART VII



				19 4	19
P ecipitati n				Sl ghtly subn rmal	V ry ma kedly subnorm l
B ding				Abunda t	Very s e
Tr n m ion				Plentiful	N ne
				Slight fall foll w d by	Cont nu d gradual fall
Cha in Spl en Mass	T at Ca	Control D ily	D i g After	Ma k d d ase in s z	Rapid d a
				G ad al in rea in i e	C tinued adual dec eas
		Alt nal D	Dur n After		G adu l decrease in size
					Gradual d c a e in i e
Cha ge in Blood Ind x	Tr ated Ca s	Co trol D ily	D ing Aft	Sl ght ed ction	Sl ght duction
				R du ed f m 66 to 0	R du d from 6 t 0
				Inc eas f om 0 to 50	Increas from 0 to 9
		Alt nal D ys	D g After		Redu ed from 44 t 11
					Inc a d f m 11 to 18
Change in Hemogl bin	Treated C	Co trols D ily	D b Aft r	C d al declin	Stationary
				Gradual d line	Sli ht in e e
				Gradual de lin	Sli ht increas
		Alte nate Day	Du ng After		Slight I c e e
					Sl ght in a e

While the subsequent e aminations were made only at monthly intervals it may be cons dered that those whose blood was consistently negative and whose spleens were either stable or diminished in size during the three or four months per od present some def nite indication of cure Fluctuations in the s e of the spleen are suggestive of a latent uncu ed i fection rega dless *of the result of the blood examinat on* On this basis we have

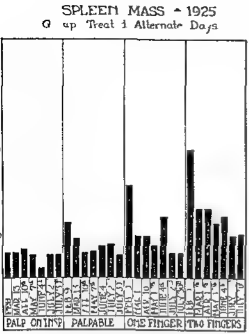
19 4—C nt l	1 o 3 5 p cent
T eated	4 4 per cent
19 5—C nt ol	5 33 3 p r t
T eat d	
D ily	14 or 58 3 p t
T t d E ry Oth Day	15 65 7 pe c nt

as showing definite evidence point g toward cure The degree of difference between the per cent of cures in the treated as compared w th the co trols represents what may be fa rly cred ted to the effect of the treat ments or in 1924 0 9 per cent and in 1925 25 and 22 5 per cent There was considerable a ophel ne den s ty in 1924 wh le anophelines were scarce n 1925 The apparent lower cu e rate f 1924 probably may be ascribed to re fectio s whil the rate of 22 to 25 for 1925 epr se ts wh t may be expecte l in the ab sence of reinfection Thus these observations essen tially conf rm the contention of Acton namely that a cure rat of approximately 5 per cent may be expected from a s ngle course of treatment Since the courses lasted 25 and 50 pe cent lo ger than the period of the standard it d es not app ar likely that 90 p cent of cures may be expected from the tandard treatment

Dr Collins (*closing*) —I trust that the meet g has not felt that my object has been to di card fore er the further use of the standard treatment that has been farthest from my mind The method appears to me to ha e its uses and there are t mes when its applic tion is most desirable One of the chief of these occasions is in the handli g of epidemics My contention how eve is that the method according to our data may have its limitations We had an example of this in the epidem c of 1924 at Gantt when despite our most strenuous efforts to get the populace to take the standard treatment which was furnished them gratis we esti mated that only 5 to 10 per cent of the people who were urged to take the treatment and who contracted to take it actually completed the course It cannot be hoped that *under these conditions the car er rate is appreciably* reduced It was in order to approximate the effect of this reduced dosage so commonly met n practice that we provided for our experimental group treated with reduced dosage That the carriers were not disposed of is obv ous from the chart showing the persistence of a posit ve blood index throughout treatment At Gantt in 1925 there was a much more satisfactory response to the use of the standard treatment Education and b tter experience had their share in attaining this im provement

Regarding the question of transmiss on raised by Dr Bass I had best expla n circum tances and allow you to draw your own conclusions We had at Leesburg this *past season the unique experience of not only having* to hunt for Anopheles mosqu toes but of being unable to find them At our routine stations establ hed for the the purpose of making large and v ried catches there were we ks at a time when we secured almost no ano pheles This applies not only to *Anopheles quadri mac latus* but to the other two species well Of three however *Anopheles quad maculatus* was the most rare at the times we could catch any at all i e during the very ea ly part of the sea on D rin the season when we would normally expect to have much malaria and many *Anoph l s quadrimaculatus* we were catching none of th s pec es and very few spec mens of the other species Dr Griffitt s catches of 0 6 *Anopheles quadrim culatus* per house with pos tive *transmiss on is remarkable but we failed to find any* fraction of an *Anopheles quad m culatus* per house and this in the m d t of the season when normally the transmiss on would have been its height It appears to me that under such ci cumstances as these trans-

CHART X



number of persons to take quinin continuously and the results scarcely justify the attempt

Dr M A Fort Bainbridge Ga—I found enlarged spleens in the southeastern corner of Terrell County Georgia and wanted to try this *experiment* but was unable to do so because I had no fund with which to finance it I asked Dr Darling at the International Health Board station 15 miles away to undertake it

I was much interested to see the treated children cease having chills and fever work better feel better eat better parasites disappear from the peripheral blood and the spleens show a marked decrease in size while the reverse was true of the controls But I was disappointed that few of the spleens became absolutely normal and that parasites reappeared in the blood of some of them after treatment was discontinued This might have been due to reinfections in the 1924 experiments but not in the 1925 experiments because it was almost impossible to find a quadrimaculatus mosquito in any home in that section in 1925 due to the drought

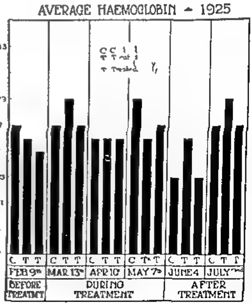
I am disappointed because quinin the only treatment we have as yet does not do so much good as we thought We are finding in the nearby county of Miller that in schools running 60 per cent enlarged spleens in 1924 only 30 per cent are now enlarged and very few of these had any fever in 1925 Some of these had taken standard treatment but some had not So it seems that if reinfections are prevented symptoms large spleens and parasites tend to disappear all of which are hastened by the long continued use of quinin In other words if you stop reinfections and give quinin religiously malaria will be cured. *If not all the first season then the second or the third* the cases rapidly decreasing in number and severity until there are no more

Dr K F Maxcy U S P H S Montgomery Ala—I wish to say a word in behalf of quinin The results which Dr Collins obtained with this population group in south Georgia confirm the work of previous investigators notably that of Dr T H D Griffitts working with similar populations under the same conditions of mass infection Although during the second season of Dr Collins observations transmission was apparently in abeyance we can conceive that this population was in an impoverished condition as regards natural antibodies Recent work has emphasized that early treated single infections of acute malaria yield readily to quinin and indeed often cure spontaneously In a lightly and transiently infected area such as is sometimes found especially in the Piedmont sections of the South a very much better result might attend the administration of quinin for control purposes

Dr M F Boyd Leesburg Ga—The observations on these children may be considered from yet another angle The results of the examinations made subsequent to the completion of the treatments may be summarized as follows

		Individuals whose blood was always negative			Individuals whose blood was subsequently positive one or more time		
Year 1924—Class	No	Spleen Dim	Spleen Stat	Spleen Fluct	Spleen Dim	Spleen Stat	Spleen Fluct
Control	8	1	0	[illegible]	4	2	1
Treated Daily	45	1	1	9	3	8	[illegible]
1925—Control	15	3		0	3	5	[illegible]
Treated Daily	4	5	9	7		0	1
Treated Every Other Day	7	3	1	8		1	1

CHART XI



This uniformity in specific rates [illegible] noticed in both areas of high and low endemicity No especial difference was noted in different races

The mean splenic volume during this period has fluctuated as follows

TABLE II—Clas if c tion of th Av r g Enla g d Sple n and of the A e ge Spleen

I—Ave a e E la ged Spleen

Group Village	I	[illegible]	III	IV	V	VI
A Sant Anna	1 72	1 9	1 4	1 6	1 71	1 8
P ta das Cai a	1 3	1 9	1 66	1 41	1 5	1 63
It mby	1 41	1 0	1 68	1 36	1 50	1 4
B M ge	1 10	1 06	1 66	1 4	1 33	

II—A age Spleen

Group Village	I	II	III	IV	V	VI
A Sant An a	1 81	1 10	1 04	1 09	1 9	1 35
P t das Cai	1 06	1 10	1 4	99	9	[illegible]
Itamby	1 0	[illegible]	1 26	1 06	1 09	6
B Mage	07	13	09	8	04	

Data not yet available

Note M g uffe ed ve ely f m epid mi ma la ia in 192 The fi t rv y data at th t place refl ct thi condition Epid mic of mala ia in Sant An a 19 4

While the crude spleen rates are of value in estimating the tangible results from malaria control the supplemental information obtained from a study of the fluctuations in splenic volume has great corroborative value as shown in Table II

The determination of the average spleen is a more useful procedure than the determination of the average enlarged spleen The most useful information would be obtained if we possessed tables giving the weight of the normal spleen at different ages and the probable weights of enlarged spleens projecting different distances into the abdominal cavity at different ages Lacking these data the use of weighted averages as here employed [illegible] the best means of bringing out these fluctuations Some attempt has been made by Christophers and by Darling to employ estimated weight in the case of pleens of children but much essential data necessary to the accurate employment of the latter procedure is still lacking

Another useful method to bring out the diminution of volume resulting from non transmission is afforded by a study of the changes in splenic volume among those individuals who have been examined successively at two consecutive surveys

The observations on which this table is based show that in most individuals malarial splenomegaly does not represent a fixed enlargement of the organ but that in a period of six months providing the spleen did not previously extend below the umbilicus its enlargement may subside or become markedly reduced remain stationary or undergo a still further increase It was never noted that spleens extending below the umbilicus could reduce in this period to anything approaching normal size

It does not appear that a marked influence on the prevailing degrees of splenomegaly can be effected during the first year of effective an[illegible] larval operations except when these are supplemented by the intensive treatment with quinin of a large proportion of those infected This was done in 1923 1924 in Porto das Caixas and Mage (where anti larval work was simultaneously carried on) and at Sant Anna as the sole measure during that season

Mention should be made of the great value of the geographic localization of splenomegaly and of its degree as a method of corroborating the field observations made to determine the important producing areas of the transmitting anophelines

(3) *Relation to the Species of Malaria Parasites*—A study of the relation of the size of the spleen to the species of parasite encountered brings out some interesting information In the course of the first five surveys 10 944 combined examinations of blood and spleen were made These may be summarized as follows

In course of all examinations made only 13 6 per cent of individuals with spleens of normal size were harboring *Plasmodium vivax* and only 2 7 per cent had *Plasmodium falciparum* A progressive increase in the incidence of *Plasmodium vivax* [illegible] noted as the size of the spleen

TABLE III—P rc ntag howi g cha g in spl nic v lum in those [illegible] utiv ly xami d

P i d betwe n r ey

	I II			[illegible] III			III IV			IV V			V VI		
A	Sta.	Dim	F L	St	Dim	E l	Sta	Dim	Enl	Sta	D m	E l	Sta	Dim	Enl.
Sant An a	35	44 4	0 4	4 8	30 1	27	53	3 1	18 7	0 5	18 3	51	45 4	2 6	3
P rto das Cai s	56 5	17 6	25 9	51 7	16 7	31 6	58 2	33 3	8 3	40 3	34 2	25 4	43 2	29 5	27 3
It mby	51 7	2 1	6	54 8	11 8	33 3	45	31 1	5	41 9	27 9	31 3	29 6	46 7	3 7
B Mage	8 8	5 1	12 1	83 6	11 4	5 1	9 7	5 9	1 3	96 7	1 4	1 8			

Data n t y t a ailable

mission could be safely excluded as a cause of the few cases of fever which were encountered in the area under observation

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THE SIGNIFICANCE OF THE DATA COLLECTED BY SPLENIC SURVEYS*

By Mark F Boyd, M D
International Health Board
Leesburg Ga

(1) *Areas Studied* —The data summarized in this paper were collected during the course of a field study continuously carried on for three years in four small towns in the coastal lowlands of the state of Rio de Janeiro Brazil The studies were prosecuted with the active interest and cooperation of the Brazilian National Health Department and that of the State of Rio de Janeiro

The villages were small their aggregate population being about 3 300 and ranging from about 250 for the smallest to 2 200 for the largest In the course of these studies six surveys were made of their populations and during the course of each from 50 to 70 per cent of all the inhabitants were examined The six surveys had the relation indicated to fever seasons of the period covered viz

Surveys	When made Month	Year	Relation to malaria Season
I	July Aug	1922	Post season
II	Jan Feb	1923	Pre season
III	July Aug	1923	Post season
IV	Jan Feb	1924	Pre season
V	July Aug	1924	Post season
VI	April May	1925	Mid season

Thus it is seen that three surveys (I, III V) reveal post seasonal conditions and two (II IV) pre seasonal conditions and the last is a mid season index The latter was purposely not synchronized with the others in order that a more severe test might be made of the results of control work as three of the villages were the seat of demonstration control work for the last two years of the period

Our constant aim was to examine as large a proportion of the inhabitants as possible including all ages and races and individuals of both sexes Some examinations were made with the subject recumbent, but the majority were examined while standing erect The varying conditions encountered prevented a uniformity in the procedure followed Spleens were examined by palpation as a rule confirming the results of the palpation by percussion in the case of those either negative or showing slight enlargement

In the expression of the results an effort was made to employ a classification that would roughly express the degree of enlargement in relation to stature It is obvious that a two finger spleen in a child of three is relatively much larger than a two finger spleen in the case of an adult and that any classification based on units of length will be unsatisfactory from this standpoint In order to avoid this difficulty and to simplify the groups used, the following classification was employed

Spleen 0 not palpable

Spleen 1 enlarged extends to the costal margin

Spleen 2 enlarged margin between costal margin and a point half way to the umbilicus

Spleen 3 enlarged margin between a point half way to the umbilicus and the umbilicus

Spleen 4 enlarged margin below the umbilicus

A survey that does not take into consideration the volume of each spleen examined neglects one of the most useful sources of information a survey may be expected to yield

(2) *Some Observations on Malaria Splenomegaly* —The data collected in the course of these examinations are so extensive that a detailed presentation at the moment is not possible and I shall limit the consideration to a few of the most important facts elicited

From the standpoint of rates the four villages are dissimilar, representing two different groups as shown below

TABLE I—Crude spleen rate

Group	Village	I	II	III	IV	V	VI
A	Santa Anna	75 9	85 4	71 6	66 6	76 4	74 2
	Porto das Caixas	73	[illegible]	85 4	71 1	60 7	68
	Itambi	7 6	76 9	75	77 1	72 7	47
B	Magé	6 7	1	6 3	2	9	

Vertical double line separates pre from post control examination

Data not yet available

The first group is characterized by very high rates and the second by very low The first are areas of high endemicity the second of low endemicity but as our observations showed subject to occasional epidemics of malaria From the standpoint of age the high spleen rates noted in those above 15 years of age are striking though at this point a diminution of the number showing parasites is noticeable

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Nineteenth Annual Meeting Dallas Tex Nov 9 12 1925

a county school in a few minutes we know accurately more about malaria in that section than microscopic examinations and many physicians can tell us If we separate the children with enlarged spleens map out where they live and drive to their homes in the warm season we find quadrimaculatus in the houses Larvae can be found in the ponds about and identified under microscope Thus in a few hours we can trace an infection to its source and give advice about drainin oiling screening quinin zation or adult destruction

Few practicing phys cians can detect a small spleen But they consider it a confession of ignorance to admit this They will not be shown and hence they never acquire the proper technic

The general pract tioner should learn to make careful exam nations of the spleen and include it in his routine examinat ons Then he mi ht tell us in what other cond tions we may expect enlarged pleens and what signif cance to attach to the finding Thus there is a small enlargement of the spleen very constantly followi g measles and th s enlargement may persist for more than s months Often I find enlarged spleens in children with enlarged tonsils and other chron c pus absorbing foci malaria being excluded

If the spleen may rema n enlar ed for a long time after the infection is gone in a imple d ease like meas es I hould like to ask Dr Boyd if a malaria spleen may not persi t for some time after all the pa asites are removed

D W llam Krauss M iph s Tenn—It is agreed that the spl en inde gives a record of recent malaria the parasite index of p esent malaria The spleen ind x is simple rapid and sati factory for f eld work The figu e ould vary w th the pe son doing the work but would be fa rly con tant for each observer On the malaria hi tories in the Memphi General Hosp tal even in the Children s Pavilion the note Spleen Not Palpable is rather frequent The histor es contain the note from the receiving ward the ntern and the hou e phys cian often also that of the attend ng Judging from this some f eld workers of local health departments m ght miss many spleens until they have become mo e expert A l ttle pecial demonstration is ind cated

D K F Maxcy Montgomery Ala—Appreciating the excellent contribution which Dr Boyd has made to th s subject I diff r with some of the conclusions which he has drawn from his work

It has been generally accepted that the spleen index i e the per cent of palpable spleens is the most dependable single index available As to the value wh ch Dr Boyd pl ces on measu ement of spleen volume I am unconv ced There are ma y considerat ons wh ch render this index of theoretical rather than practical value

The so called average spleen and the average enlarged spleen expressions wh ch were ad ocated by S r Ronald Ross in 1908 are we ghted averages As a general proposit on it seems to me that a direct expression of idence such as is the spleen index is more dependable and its significance easier to understand than is an expression weighted by arbitrary values

Aga n observations based upon fluctuations in the size of the pleen can only be util zed where the group examined is suffic ently large and the spleen rate suff c ently high to admit of breaking up into five classes which are large enough to be stati tically significant Especially is the last class spleens enlarged below the umbilicus apt to be very small Before inferences can be safely drawn from the figures derived for the average spleen and the average enlarged spleen the probable error due to the fluctuations of chance sl ould be considered and it is difficult to calculate the probable error of a wei hted average

When we peak of measurement of spleen volume in this connection it seems to me that we imply a degree of accuracy which is hardly warranted by the method It is po sible to estimate only one d mens on of the spleen its len th and that very roughly Dr Boyd pointed out that the express on fin es breadth has a significance varying accordin to tature It i al o true that there is great variation n the position of the costal margin in narrow chested and in w de chested ind vi luals In some the pleen enlarges more toward the mid line in others more in the downward d r ction Because of these and other cons derat ons Christophers and h s co workers in Ind a have given up the costal margin as a basi of mea urement and ha e attempted to fix the pos tion of the spleen apex by means of two measurements and a projection upon an abdominal chart

Most of Dr Boyd s observat ons on spleen olume were made n the tanding position some with the subject recumbent according to the exi enc es of field conditions Certainly any method of exact measurement mu t have as a fundamental that all exami nat ons be made alike in this espect

I po nt out these difficulties in the method simply to ra se the question whether after all the information given by these painstaking and time consuming measurements of spleen size is as dependable and the sig n f cance as ea ily understood as is the simple statement of the per cent of persons with a palpable spleen, examined with uniform techn c Certa nly as far as the United States is concerned there are very few localit es where stat stically s gnificant groupings of th s sort a e available In this country the greatest value of pleen examination attaches to a simple statement of the percentage of pos tives fou d and the use of these posit ves in locating malaria foci

The conclus on that splenomegaly is more closely a measure of the incidence of infection w th *Plasmod um vi ax* than of *Plasmod um falciparum* does not seem to m to be d monstrated by the data presented The rat o of the f nding of *Plasmodium v vax* to the finding of *Plasmodium falc pa um* is approximately the same four to one in the group w thout as it is in the group w th plenic enlargement except in those with very large spleens where the group is too small to be signif cant It must also be borne in mind that the finding of one species of parasites on a single examination of the peripheral blood does not exclude the presence of the other in small numbers, or latent

TABLE IV Relat on between the Size of Spleen and the Species of Parasite Encountered in the Blood Excluding Mixed Infections

	Class of sple ns 0	1		3	4
A H ghly end m areas					
No Spleens	884	046	6 9	45	96
No with P Vivax	11	450	161	84	31
P cent with Vivax	0		6	34 3	3 3
No with P falc	43	100	38	1	3
Per c nt P falci	4 9	4 9	6 1	8 6	3 1
B Mage low endemicity					
No spl ns	5 03	9	69	0	0
No w th P vi ax	70	64	9	0	0
Per c nt with P vivax	1 4	3 5	13	0	0
No with P falci	124	10	0	0	0
Pe c nt w th P falci	4	3 7	0	0	9

increases though a slight decrease is noted in those where spleens extend beyond the umbilicus as compared with the next smaller class *Plasmodium falciparum* infections do not show such a close correspondence to the size of the spleen and this parasite is less likely to be found in individuals with very large spleens than in those without splenomegaly

During epidemic periods a much larger proportion of persons with normal as well as with large spleens are found to harbor *Plasmodium falciparum* Where the endemicity is high the proportion of persons with negative spleens who show parasites is higher than in areas of low endemicity

(4) *Relation to the Incidence of Fever*—Another interesting relationship exists between the size of the spleen and the incidence of fever Monthly visits were made to all houses to elicit the incidence of fever during the month and the fever data are probably more complete than is usually noted The monthly fever rates for Sant Anna for 1922 1923 classified according to size of spleens at the midyear period are given in Table V as being typical It is to be noted

(1) That the incidence of fever in this group tends to vary directly as the size of the spleen

(2) That those presenting slight degree of splenic enlargement show the most constant monthly incidence of fever

(3) But the early incidence of the season tends to be proportionately greatest among the possessors of the larger spleens (while the fever late in the season is more common in those who had small or negative spleens)

(4) The highest incidence of fever is among those who have class 3 spleens the possessors of the largest spleens (4) suffer less from fever This is parallel to the incidence of parasites

SUMMARY

(1) The determination of spleen indices or rates is the quickest and simplest method of ascertaining the extent of malaria infection in a community

(2) Unless the work is done in an area whose endemicity has been determined individuals of all ages should be examined

(3) When properly analyzed these data permit one to judge the degree of endemicity that has recently prevailed

(4) Splenic data also serve well as criteria of the results obtained by control work The use of rates should be supplemented by expressions illustrating the fluctuations in splenic volume

(5) Splenomegaly is more closely a measure of the incidence of infections with *Plasmodium vivax* than with *Plasmodium falciparum*

(6) Individuals with very large spleens possess a noticeable resistance as compared with those having moderate degrees of enlargement

(7) The determination of splenomegaly affords the simplest means of determining those in most need of intensive treatment of quinin

DISCUSSION (Abstract)

Dr M A Fo t Bainbridge Ga—The two greatest aids to a malaria control worker in the South are first examination of the spleen and second identification of anopheles larvae with the microscope

If we examine the spleens of the small children in

TABLE V Sant Anna Ca of Feve 19 19 3 among tho e Examin d in Su vey II clas ifi d by Spl en group monthly rates p r 100

Spleen Clas es	19 J	A	S	O	N	D	Months 19 3 J	F	M	A	M	J	Ann al Rat s P 100
0	100			—		50	50	50	1 0	250	00		87 5
1		1		—	2	64	3	117	106	181	244	[illegible]	0 7
2	70	—	0	141		70	212	93	83	70	4 4	1	153
3	300	300		—	300	600	300	300	300	300	300		250
4	00		—	—	—	00	200	00		—	400	00	116 8

islatures funds that can be used for training the personnel

The Board's participation in malaria control activities in the United States during 1925 has continued along established lines. Financial aid is given to the state boards of health for state and county projects. The expenditures have been chiefly to provide epidemiologists and sanitary engineers who will devote themselves specifically to malaria work. They endeavor to define the malaria problem in the various counties to develop county health organizations to feature malaria control and to train the county personnel. They supervise the work in the state and serve the county and town authorities in a consultant capacity. The Board has aided also by making contributions to county budgets. The aid given by the Board is considered as relatively temporary. The state and county are committed from the beginning to the assumption of the entire expense as rapidly as practicable.

The county organization for combating malaria is essentially the same in character as that engaged in general public health work. The size of the county in area, population and wealth determines usually the size of the county budget and the amount of personnel. The smallest unit that has been tried consists of a health officer and a public health nurse at a yearly cost slightly in excess of $6,000. A few small Virginia counties are operating on this basis. The representative from that state can speak of the work and the efficacy of such a unit. It is smaller than is desirable. It would be advantageous to make the minimum unit contain also a sanitary inspector and an office assistant and these items cannot be added without an additional fund of $3,000 or $4,000. This means the minimum budget would be $9,000 or $10,000 a year. Where practicable it is desirable to increase the number of nurses and sanitary inspectors. This can be done without increasing overhead expenses. Consequently the larger unit makes for economic efficiency. Some units are able to have a laboratory technician. If a competent one is obtainable the value of the county work will be greatly increased. Each member of the county staff has definite duties to perform. The health officer supervises the work and does the work which cannot be done so well by the nurse, sanitary inspector or office assistant and delegates to the other staff members such duties as they can perform satisfactorily and more cheaply than he can perform them himself. Drs. Maxcy and Smillie submitted in New Orleans last fall a program for county-wide malaria control by the county health organization. The Public Health Service will I presume publish this plan. Doubtless many of you are already familiar with it. It is needless for me to say that growing experience and a larger number of trained workers will lead to increased efficiency in county-wide control measures.

The record of the Board's participation during 1925 to date in the control measures mentioned is shown in the accompanying table.

It will be noted that aid has been given to nine state boards of health to central administration and to nine states toward 41 county organizations. The cumulative figures since the Board's cooperation began about five years ago are:

No. states aided	9
No. towns aided	117
No. counties aided	41

The Board's contribution in no instance has exceeded 50 per cent of the cost of the central supervising staff or 25 per cent of the cost of the county organization.

Plans for 1926 contemplate a continuation of the program outlined above.

61 Broadway

MALARIA CONTROL ACTIVITIES IN ALABAMA*

By S. W. WELCH, M.D.
State Health Officer
Montgomery, Ala.

The plan in 1924 of doing malaria control work through the health units of the several counties was partially followed in 1925. Instead of working intensively the engineers only went on call. Work was undertaken in all of the twenty-eight organized counties except five. The foci were classified as follows:

Known endemic foci	118
Number of these surveyed	87
Number of foci eliminated	10
Number of foci partially controlled	45
Number of all foci under maintenance	34
Population protected	336,771
Cost of control (labor and material)	$43,851.30

The cost of control does not include the money spent by the Federal Government on Wilson Lake or any of the impounded projects.

An understanding of the scope of the above items can best be obtained through a consideration of the interpretation placed upon them by the Alabama State Board of Health. Considerable attention has been given report forms during the present year. In the case of malaria control there has been an evolution in the method of reporting. Formerly activities alone were reported. This organization now is giving attention to results. The above summary is offered as evidence.

Attached are the report form now in use and a copy of the interpretation of the items. These have been devised by the Bureau of Administration in collaboration with the Bureaus of Epidemiology and Sanitary Engineering following up a plan suggested at a conference a year ago with the health authorities of North Carolina, Ohio, the United States Public Health Service and the International Health Board.

IMPOUNDED WATERS

In 1924 there was a very severe outbreak of malaria in the territory contiguous to Gantt due to the fact that no control measures were applied. Legal measures were instituted to compel the company to apply control measures. Prosecution was withdrawn when the company voluntarily agreed to enforce the regulations of the State Board of Health governing impounded waters. The impounded waters were released

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*Report from Member of Subcommittee on Administration, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Nineteenth Annual Meeting, Dallas, Tex., Nov. 9-12, 1925.

MALARIA ACTIVITIES*

By JOHN A FERRELL M D,
International Health Board,
New York N Y

The International Health Board has continued its malaria field studies and its training station for personnel at Leesburg Georgia Dr Boyd is now Director having succeeded Dr S T Darling deceased Developments tending to broaden our knowledge of malaria will be reported by Drs Boyd and Collins

The training station has provided training for 42 of the International Health Board staff members and fellows The majority of them are now serving in foreign countries Twenty three health officers scheduled for state or county malaria control work have taken training at the station As malaria control measures cannot be made effective without competent trained personnel interest should be focused on improving and enlarging facilities for training Dr Boyd is now giving consideration to broadening the scope of the work of his station so that the problems presented in different sections may be studied, and the efficacy of the methods of control employed may be checked He has in mind continuing observations in southern Georgia where the lime sink is the chief source of the breeding of the malaria mosquito He will extend his observations to the anopheles breeding areas of the tidewater countries and also to the hydro electric reservoirs in the hills The students in addition to studying the factors which produce malaria will be afforded opportunity as far as practicable to become acquainted with effective control measures for each type of malaria problem No feature of the malaria program outranks in importance that of training personnel for the directive positions.

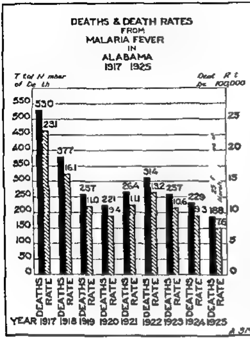
In order to make it possible for the state directors and county health officers including those already at work and new ones about to begin work to take special training in malariology the Board as in other branches of public health work has aided the state to supply traveling expenses and where necessary stipend to appointees through brief periods of training The health officers usually spend from two to four months at the training station When states have no funds that can be used for this purpose the Board in meritorious cases has supplied the entire amount. It is hoped the wisdom of having all new health officers for malaria work obtain at least a few months of preliminary training will be so conclusively demonstrated that the states will obtain from the leg

* Report f om Memb r of Sub committee on Administration National Malaria Committee (C nf rence on Mala ia) meeting conjointly with Southern M dical Associat on Nin teenth Annual Me t ng Dallas Tex Nov 9 1 19 5

NUMBER OF TOWNS AND COUNTIES IN WHICH THE INTERNATIONAL HEALTH BOARD HAS AIDED TOWARD CO-OPERATIVE DEMONSTRATIONS IN MALARIA CONTROL

	1920			1921			19 2			19 3			1924			1925			Tot 1		
	Town	C ty	C tral Admin.	Town	Cou ty	C tral Adm	Town	C unty	C tral Adm	Town	County	C tral Adm	Town	Cou ty	Ce tral Admin.	Town	Co ty	Ce tral Adm	Town	Cou ty	C tr 1 Admin
Al bama	7			4			3	1	( )	4		( )			( )		3	( )	18	4	1921 5
Arka	7			1					( )			( )			( )			( )	8		1921 25
gi	4											( )			( )			( )	4		1922 25
Loui i na	3			1						3	1	( )		1(1)	( )		(2)	( )	7	2	20 23 25
Mi i ippi	6			7			5(1)	1	( )	2	1(1)	( )		(2)	( )		4	( )	20	6	1921 [illegible]
Mi i								6			1(2)			(2)			(2)			7	1921
N C li	4			1							4			3(4)	( )		(3)	( )	5	7	1923 25
S Ca lina	4			9(3)		( )	4(3)		( )	3(1)	1	( )		2	( )		(2)	( )	20	3	1920 25
T nn	2			2			2				3			(2)			(2)		6	3	
T xa	10			5							2	( )		(2)	( )			( )	16	2	1922 25
Vi gi i	5						4(1)		( )		4	( )		2(3)	( )		1(4)	( )	9	7	19 1 25
Illi i							1			2			1			1(1)			5		
T tal w p rati	52			0		5	19	8	2	14	17	1	1	8		1	8		117	41	9
Ac um l tive t d t				3		1	5		5	1	3	8		16	9	1	18	9			
GRAND TOTAL FOR YEAR	52		2	33		6	24	8	7	15	20	9	1	24	9	2	24	9			

C tral Admi i tr ti n.
(1) Fi u e i p th i p t tiviti whi h we tinued
NOTE K budg t f s rvey i Calif rni



n that area and temporary measures such as the use of larvacides or fi h can be abandoned

Number of Foci Pa tially Controlled.—A focus may be said to be partially controlled when there is a d crease in the number of cases (not relapses) when compared with the number that occurred dur ng the p eced n sea on prov d d that the decre se s a di r ct or ind ect result of control mea ures instituted by the health officer

Note Th s item refers only to th se foci o e wh h co trol h s not been previ usly e ercised Control of old foci s dealt with in the next item

Nu be of Old Foc Unde Maintenance—In a number of places in the state cont nuous c ntrol of old projects is nece ary Dothan Mob le a d Selma are e amples This item has therefo e been entered to cover ma ntenance of areas that form ly were foci and tl at wo ld probably become foci again if con t nuous control were n t maintained

P pulat on Protected—Th s figure will represent the number of ind viduals p otected as a result of the complete el mination of foci the partial co trol of foci and the mainte ance control of old foci provided the individuals live w thin fl ght ran e (1 m les) of the a eas in questio

Cost of Cont l (Labo and Material)—Self-explanatory

MALARIA CONTROL ACTIVITIES IN ARKANSAS*

By C W GARRISON M D
State Health Officer
Little Rock Ark

Malaria control activities in Arkansas for the year 1925 have comprised ma nly the cont nuance of con trol measures in the old urban un t with the addi tion of several n w mun c p lities unde takin the work for the f rst time Surveys ha e been made in a number of cities contemplatin control measures and reports subm tted with recommendations as to procedure Two of the c t es doing work in previous years rela ed greatly in their efforts during the pa t season making the effectiveness of thei efforts al most negligible n so far as materially reducin the mosquito population

In addition to the urban units regular visits were made to the four District Agricutural Colleges where control measures were being conducted The chief pur pose of our efforts at these colle es is accurately to inform the students regardin the cause of malaria and practical methods of pre enting mosquito breeding

The Crossett Lumber Camp has continued its ac tivities and has maintained almost perfect control under the most difficult circumstance The State Boys I dustrial School has do e effective work which has a great educational value

The St Louis Southwestern Rock I l nd and Mis souri Pac f c railroads ha e contin ed thei pro grams the latter makin ma y e t nsions in the num ber of persons protected The outstandin feature in connection with the ra lroad work was the educational campa gn put on by the Missouri Pacific railroad through the Better Health Special Train which went o er the Company s l es n Arkan as ting ninety cities betwee July 20 and Augu t 13 This train consisted of an exh b t car lecture car bag age and equ pment car diner and pullm n fo the train per sonnel The purpose of th train was to awaken a more active nterest in publ c health probl ms with particular empha s upon malaria It was a notable success and of inestim ble alue from n educational standpoint The total number of persons passing throu h the exh bit car was 38 000 a large number bein from the rural d t icts The Missouri Pacifi ra lroad is doing a great wo k in Arkansas not only in protecting its employees ag nst malaria infection I t in educating thousands of citizens of th tate as to the cause and preventio of this disea e

The new paper publ city given to m laria control work throughout the state deserves pec l mention It would seem that the nterest manifested indicates clearly upon the part of the n wspapers a desire to bring the whole state to recog e d fin tely th t ma laria is largely a preventable d sease and should be at

*R p t from M mb f S b mmittee on Ad mi i trati N tl I Malaria Committ (Conf e c on M la ia) m ti g conj i tly with S uth rn M dical A oci ti Nin tee th A u l M ti g Dallas T Nov 9 1 19 5

(Report only at end of year s control activities not later than December 1)	Beginn ng of Se on	Increa e Du ng Season	Decrea e D ing Sea n	Total at End of S a on
Known en lem foci in county No of these su eyed			XXXX	
No f foci eliminated No of foc partially controlled No of old foci under maintenance Population prot ct d Co t of control (l bo and mat r al)	During S ason			

and the basin cleared and quinin used freely by the county health unit The control measures adopted resulted in a reduction of about two thirds of the number of cases of malaria for 1924 Standard quinin treatments will be carried on through the winter and we hope to have a larger number of carriers elimi nated before the opening of the season in 1926 The company will begin active control measures with the opening of the 1926 season

Two other large impounded projects were in process of construction during the year Cherokee Bluff by the Alabama Power Company which will be one of the largest impounded water areas in the country and the other is at Bartlett s Ferry on the Chatta hoochee River between River View Alabama and Co lumbus Georgia Both of these companies have co operated very ordially in complying with the regu lations of the State Board of Health governing im pounded waters

A large number of small projects have been con structed The promoters of these smaller projects have conformed to the instructions of the State Board of Health in mosquito control work

It is too early to give a positive statement of the number of deaths from malaria The cases reported up to December 1 indicate that control measures have resulted in a further decline of the death rate from this disease in Alabama Attached hereto is a chart showing the death rate from malaria in Alabama since 1917

Considerable work has been done in the improve ment of methods of control Mr J C Carter of the United States Public Health Service worked out an improvement of the apparatus used by Dr T H D Griffitts for spraying oil upon areas of impounded water A cut of this apparatus has been furnished the United States Public Health Service and will appear in the report of the State Board of Health for 1925

Another method of control worked out by the Ala bama Power Company and more completely and ex tensively applied by Stone and Webster at Bart lett s Ferry was the tieing down of felled trees so as to prevent floatage when the water was impounded This promises not only to be a great aid in the con trol of malaria but a very profitable investment from an economic standpoint to the company

The control work by the Federal Government on *Wilson Lake was not* as effective as it might have been The top minnow supply was very numerous and probably aided very greatly in reducing the mos quito output The methods for oiling were not as *successful* as they might have been had different equip ment different methods and more adequate machin ery for praying been used It is hoped to get these minor difficulties removed before the beginning of another season

Another step in the control of impounded waters on navigable streams has been taken with pecial reference to Lock 18 on the Coosa River Here the Federal Power Commission made their permit con form to the major requirements concernin construc tion and preliminary preparation as prescribed by the State Regulations

Foreword —By malaria control is meant the estab lishment of mea ures which re ult in a partial or com plete suppre sion of malaria

Known Endemic Foci in County —The term en demic focus is used to describe an area in which ma l ria is being transmitted For the purpose of uni formity in reports all anopheles producing areas in an urban community where malaria is being tran mitted would generally be classed as one focu Foci listed in rur l sections would only be given eparately when such areas were not within two miles of one another

Note The column head ng beginnin of sea on provides for the recording of all foci in exi tence at the be inning of the season s control activities If additional foci developed durin the season they should be recorded under increa e during season If foci are eliminated (ee definition below) the num *ber eliminated will fall under decrease during sea* son Total at end of season will then be the num ber at beginning of season plus increase during sea son minus decrease during season Further the total at end of season should equal the sum of the number of foci partially controlled plus the number of old foci under maintenance (see definitions below) plus those foci over which no control was exercised during the season the latter not appearing as an individual item in the report but which f gure the central office may obtain by deducting the number of foci partially con trolled plus the number of old foci under maintenance from the total at end of season

Number of These Surveyed —It may be said that a focu has been completely surveyed when the exist ence of an anopheles producing area has been demon strated and the existence in this area of cases or car riers has been establ shed (by blood spleen examina tion or both A history index unsupported by blood or spleen examination is not considered sufficient)

Note The column head ng total at end of season as applied to the number of foci surveyed is the sum of the number at the beginning of season plus in crea e during season (if additional foci have devel oped and have been surveyed)

Number of Foci Elim nated —A focus is eliminated only when new cases (not relapses) cea e to appear

promotion of malaria control on a parish wide basis through the full time parish health unit

A very extensive development scheme to include provision for navigation irrigation and power development is being promoted by private interests and brings up the problem of impounded waters and their probable influence on malaria. Regulations have been adopted on this subject

The board is interested and is giving its support to a plan being promoted by officials and business interests of Alabama, Mississippi and Louisiana to investigate the the salt marsh mosquitoes with a view toward abatement of the Gulf Coast mosquito nuisance

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MALARIA CONTROL ACTIVITIES IN MISSISSIPPI*

By F J UNDERWOOD M D
State Health Officer
Jackson Miss

Beginning in 1922 the malaria control program of the Mississippi State Board of Health was made to apply primarily to county wide projects

A division of malaria control is maintained as part of the central organization to render aid and advice and encourage the development of malaria control throughout the State with special reference to full time county health departments

There are 13 active full time cooperative county health departments at present in the State of Mississippi. Five of these counties are in the true malaria belt and have problems in malaria which are considered to be of sanitary importance while the remaining counties have more or less malaria to deal with yet their rates are hardly comparable with those counties in what is termed Mississippi's malaria belt

The plan of the Mississippi State Board of Health in instituting malaria control work is essentially to make a study of the problem within any given county, determine the foci of infection and the contributing factors thereto and decide what suitable inexpensive methods can be employed to control the disease

In the spring of this year such a survey was started in Coahoma County which maintains a full time health department and conclusive information has been obtained which indicates the true status of malaria prevalence in the county and a practical program for next year is being mapped out to be instituted by the county health department

In one other county in Mississippi which unfortunately does not maintain a full time county health department there being a part time health officer having under his direction the accepted standard full time personnel, malaria control work has been continuous for the last four years with marked results. A program was instituted in this county in 1922 and its value proven before adoption by other counties in the State

For the year 1926 it is planned to carry on malaria control work as part of the regular program in each full time county health department in the State where malaria presents a problem of sanitary importance. With the beginning of 1926 there will be 21 active full time cooperative county health departments in the State

A study of the situation in Mississippi reveals the fact that no definite program to control malaria can be decided upon in any given area until it is first determined what the problem is so far as the distribution of malaria goes and those factors contributing to it and the methods of control which might be put into practical use

For this reason it is essential that full time county health departments should be rendered advisory aid from the central office which makes a division of malaria control with an adequate personnel imperative to the success of the undertaking

With this in mind steps have been taken to expand the personnel of this division and render assistance to additional counties in adding malaria control to their present program

The successful control of malaria as well as any other health menace requiring field sanitation rests with adequate and well trained field personnel. In this respect well trained sanitary inspectors attached to full time county health departments are required. After a malaria control program has been instituted in a county it is expected that the personnel connected therewith and the operations of the program shall be absorbed into the general program of the county health department and made a permanent part thereof

That malaria can be controlled on a county wide basis has been most strikingly demonstrated in Mississippi where in one of our counties after four years of continuous work there has been a reduction in malarial fever of approximately 80 per cent bringing the rate from one of the highest for any county in the malaria belt to one comparable with those in counties where malaria is not considered of great sanitary importance. The cost has been surprisingly low and the program practical in all respects is being used as a model for other counties in the State

In general the status of disease reporting in Mississippi is highly satisfactory. Of the nearly 1 500 physicians practicing in the State reports are received monthly from approximately 96 per cent of the number

Different values may be placed upon these reports and so far as malaria is concerned the reports give an excellent comparison and serve as a guide in segregating and studying the problem

Mississippi is in the registration area for deaths and accurate information is available at the close of each year regarding deaths from malaria

Special efforts are made to encourage laboratory diagnosis of malarial fever and during the last two years the number of examinations made will have increased from approximately 10 000 to 12 000 blood examinations per year

Educational work in regard to malaria control is constantly carried on and a very marked interest has been shown recently by commercial bodies within the State

The Mississippi State Board of Development has been most considerate in thoroughly going into the malaria problem and studying its economic relations in the development of the State and has lent its support in a number of ways to furthering the program of the State

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*Report from Member of Sub-committee on Administration, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association Nineteenth Annual Meeting, Dallas, Tex, Nov 9-12 1925

tacked with vigor by every official and voluntary agency within the state.

The Rock Island lines in Arkansas have been conducting excellent publicity work and following a survey which is now being made by the Sanitary Engineer of the St. Louis Southwestern railroad it is expected that active control measures will be instituted.

No county-wide malaria control work has been undertaken but considerable rural work has been done in a number of counties, particularly Pulaski, which has a full-time county health officer who is giving attention to the malaria problem.

Briefly summarizing, the season's activities have resulted in continued protection to citizens in urban units, some of which have been doing the work for seven to eight years. A more wide-spread interest in the prevention of malaria is most notable, largely through the excellent work of the Missouri Pacific railroad and the St. Louis Southwestern railroad. It is my experience that the citizens of Arkansas are rapidly learning the story of malaria infection and prevention and we have reason to hope for a marked reduction in the incidence of this disease during the next few years, particularly in the cities.

The rural malaria problem is most difficult in Arkansas, but with the assistance of the county nurses, rural school teachers and Home and Farm Demonstration Agents, all of whom are assisting in educating the rural residents, it is felt that some progress is being made.

The urban population protected during the 1925 season was approximately 250,000, living in thirty cities.

No new methods of anopheles or mosquito control have been employed, although observations on the effectiveness and economy of certain larvicides have been continued. It is our opinion that there is no larvicide with which we have had experience that is more economical than oil for treating natural breeding places. The use of larvicides in fire barrels and artificial containers is effective and sometimes more desirable than oil.

Several of our cities in the rice belt are desirous of undertaking the control of mosquito breeding in the adjacent rice growing territory by spreading arsenic dust by means of aeroplanes. It is hoped that the effectiveness of this method of control can be determined next season.

A long experience confirms the conviction that the state should continue to exercise more or less general supervision over malaria control work in the urban districts. Limited experience and extensive conversation with rural workers in other states forces the conclusion that rural malaria control as affects a state or the South can accomplish little until large appropriations from the Federal, state and local governments and voluntary agencies are available and a far more intensive and comprehensive campaign is launched than is being done or can be done by a county health department, even though the department be adequately provided with funds and personnel for executing a well rounded health program exclusive of malaria control.

MALARIA CONTROL ACTIVITIES IN FLORIDA*

By F. A. BRINK, M.D.,
State Board of Health,
Jacksonville, Fla.

On account of the unusual activity in Florida real estate the general public has taken less than the usual interest in malaria and mosquito control.

The State Board of Health has been handicapped somewhat by the lack of personnel. Its anti-malaria activity has consequently been limited to a mosquito survey of the city of Tampa and environs and the giving of advice to local authorities by the field men of the Engineering and Communicable Disease Bureaus.

Large areas adjacent to centers of population are being drained and filled preparatory to the sale of subdivisions and thus many mosquito breeding areas are being eliminated permanently.

The cities of Jacksonville, Miami and St. Petersburg do active mosquito control work regularly.

Fort Pierce, Vero and Indrio have authorized preliminary surveys with a view to the establishment of drainage districts and issuing bonds for money to control mosquito breeding. We hope we shall be able to do more effective malaria control work during the coming year.

MALARIA CONTROL ACTIVITIES IN LOUISIANA*

By OSCAR DOWLING, M.D.,
State Health Officer,
New Orleans, La.

The State Board of Health has given engineering supervision to malarial mosquito control campaigns in twenty different communities. Surveys and cost estimates are made for those who are interested and are considering undertaking the work. Surveys to determine extent and distribution of malaria incidence have been made in four parishes and plans for control work in these parishes have been furnished the director of the Parish Health Unit.

In two of the units the State Board of Health is giving engineering assistance in making surveys and cost estimates, running levels and promoting the work. Particularly good results have been secured in Natchitoches Parish due to the very excellent cooperation received from the public officials and the public in general, an organization known as the Citizens Anti-Malaria being of considerable assistance in furthering the progress of the work.

We propose next year to continue along the same lines. We will endeavor to extend our surveys of incidence in one or more new parishes and to continue in

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MALARIA CONTROL ACTIVITIES IN NORTH CAROLINA*

By H. A. TAYLOR, M.D.
Deputy State Health Officer,
Raleigh, N. C.

The department created and assuming the administrative duties for the control and investigation of malarial fevers in North Carolina is financed jointly by the State Board of Health and the International Health Board. The department thus created seeks to organize local county health departments whose duty it is to carry on investigations and control measures wherever the disease is prevalent enough to justify the effort and expenditure of money. While the primary object of the department created is necessarily the mapping out of the malarial problem in all the counties within the malaria zone and instructing employes of local county health units in measures for the control of the disease there is a secondary object of even greater importance—that is the stimulation of permanent interest and activity in public health work in general and the local administration of methods whereby disease prevention can be carried on economically and on a large scale by free and generous support of full time local health departments.

The department created has been instrumental in organizing seven full time health departments located in the malaria zone of the State whose duties are confined principally to the control of this disease. The departments operate on an annual budget of $10,000 per year, with a personnel consisting of a full time medical director (county health officer), two field assistants, one microscopist and one clerical assistant. Each department, with a health officer acting as executive head, assumes full responsibility for intensive control measures in the respective counties, and while there are certain mandatory activities to be taken care of by each department, special effort is made to have at least 75 per cent of the time of each employe devoted to the control of malarial fevers.

The management of all seven of the departments known as counties doing malarial work, the supervision of all financial transactions and the purchase of all supplies are functions of the office of central administration. At the central office there is a clerical assistant who has immediate charge of the bookkeeping and who concerns herself directly with the clerical features of this particular phase of the county health work.

On completion of the organization of the departments, the health officers seek to outline or determine the areas of concentration of the disease in their respective counties and in view of the fact that malaria is essentially a rural disease, control measures are confined principally to the rural section and small villages of the county. The first step of the departments has been to gather data as to the apparent prevalence of the disease in the county by the examination of school children between the ages of 7 and 12 for enlarged spleens, the taking of history indices as to positive or negative malaria, the establishing of blood indices and the securing of mortality statistics from the State Board of Health. From the data elicited during this preliminary survey the health officer obtains a fairly accurate idea as to the prevalence and distribution of the disease in his respective county. From such records it is naturally shown that certain foci of infection exist in the county and are the only areas requiring immediate control measures. Having established the area or areas where the disease is most prevalent, the department prepares a survey or spot map showing each home thereon in relation to permanent collections of water, with special reference to those streams breeding malaria mosquitoes. In areas where anti-mosquito measures are considered feasible all the collections of water are indicated on the survey map and character indicated as to whether permanent or temporary. The density of mosquitoes in relation to occupied houses is a feature also of the department. From the data elicited during this survey the health officer is in position to determine the most feasible and economical measures of control, which in the tidewater section consists of a combination of all measures at our command.

It is a purpose of the board to continue and extend measures for the control of malaria as rapidly as the organization and funds will permit. The problem which will confront us during 1926 is the impounding of water for hydro-electric purposes. The plan now in effect for handling such problems is to extend the malaria and mosquito survey over the areas of any proposed project for at least twelve months prior to the impounding of water for the purpose of determining what, if any, influence the impounding of water may have upon the mosquito rate or malaria incidents. The same measures employed prior to the impounding of water will be extended over a period of not less than twelve months after water has been impounded. By such methods it is hoped to obtain comparative data which may be used as a basis in formulating rules and regulations for the control of similar projects.

*Report of a Member of Sub-committee on Administration, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Nineteenth Annual Meeting, Dallas, Tex., Nov. 9-12, 1925.

MALARIA CONTROL ACTIVITIES IN SOUTH CAROLINA*

By JAMES A. HAYNE, M.D.
State Health Officer,
Columbia, S. C.

The malaria control work in South Carolina during the current year has consisted of routine measures heretofore employed, principally drainage, the use of quinine and screening. The operations have been carried on in counties where county health officers are stationed. The first requisite in doing malaria control work is to find out where malaria exists. Last year much work was done along this line by means of the school census card. This year the school census card was not employed extensively because the time of the personnel was taken up with collecting weekly reports from physicians on communicable diseases, the plan of sending out cards each week having been adopted in March of this year.

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Board of Health. Chambers of commerce have been active in oliciting information relative to malaria versus industrial development and it is particularly evident at this time that with sufficient appropriation the Mis is sippi State Board of Health will be able to make greater strides in the future toward eliminating malaria than have yet been thought of in the past

During the last 10 years malaria morbidity has been reduced 50 per cent and mortality 86 per cent the great est part of this reduction havin occurred since 1921

MALARIA CONTROL ACTIVITIES IN MISSOURI*

By JAMES STEWART M D
State Health Commissioner
Jefferson City Mo

Malaria was once prevalent through Missouri but with the contraction of the malaria zone Missouri like many other States of a similar latitude has been freed of the infection with the exception of a few ep demic foci namely in the order of their importance (1) the so called Southeast Missouri section (2) the Missouri River bottom (3) to a certain extent the areas con tiguous Scattered throu h the State occasionally there will be reported a case of malaria or a death from this disease In some in tances these will be true malaria but more often their basis will be residual recollections rather than residual or new infection A problem now pending but not yet present is the control of malaria in impounded waters

Southeast Mis ouri is essentially a part of the Mi sis sippi Delta region fam liar to all of you which has been reclaimed throu h an elaborate system of drainage Deforestation has gone on simultaneously with ditching since about 1900 and now the section is practically clear of timber and stand ng water At first general farmin was followed but recently because of the ravages of the boll weevil in the South and the rising price of cotton general farming has been entirely sup planted by cotton farming and changed the entire composition and character of the population Southern negroes are daily mi rating into this section and taking the place of the tenant whites who formerly tilled the soil

Ind rect malaria control measures that is ditching have been going on since 1900 but have been consid ered as an agricultural rather than a health measure Direct control measures were started about four years ago along the following l nes Education screening individual farm drainage and to a limited extent ditch maintenance Whole-ale quininization was thought of but abandoned The towns and the better rural homes have been practically freed of malaria but among the tenant population all that was accompl shed toward im proving their homes has been practically nullified throu h the change in the character of the population Malaria was recently made a reportable disease but up to date reporting has been very incomplete The deaths from malaria remain more or less tationery with ome fluctuation from year to year Recently we have been sending questionnaires to each physician reportin a malaria death About 50 per cent have replied giving information that clearly shows that the cause of death was not substantiated by laboratory examination Our State Board of Health laboratory was established a little over a year ago It has not been used extensively as yet for the diagno is of malaria but of the slides submitted up to date less than 10 per cent were pos itive all of which indicates that our present informa tion is by no means authentic The fragmentary knowl edge which we have however together with surveys that we have made leads us to believe that the malaria problem in Southeast Missouri is rapidly disappearing and its final eradication will ultimately resolve itself into a problem of ditch maintenance Except in the early sprin the ditches are the only bodies of water remaining for any period of time The soil has now been practically dehydrated and the general ground water level has sunk from what it was a few years ago about 10 or 12 feet to about 16 or 18 feet We are now concentrating our efforts on ditch maintenance believing it to be a po itive and single method of permanently eradicating malaria Most of the drainage districts have e tablished a maintenance fund The amount of clearance varies One county with 550 miles of ditches reports 131 miles cleared during [illegible] months of 1925 This i the greate t amount of clearance re ported from any one county for a similar period We are making an epidemiological investigation to deter mine primary foci of infection with a view to concen trating our efforts on the e areas

Malaria in the Missouri River bottoms is not a prob lem of any magnitude The chief outbreaks reported have been in boat crews and other itinerant workers

Malaria in the hill areas is poradic In former years when the tenant population of Southeast Missouri was drawn from the adjoin ng hill sections these localized outbreaks of malaria were more frequent but in almost every instance so far as our knowled e goes and for reasons with which we are not familiar the disease wore itself out in a season

Just what our problem with the impounded water will be I am unable to antic pate For several years there has been a dam on the White River backing the water up for several miles throu h a rather narrow ravine with wooded edges This has been developed into quite a re ort region Nothing extensive has ever been done to combat malaria in th s area and neither has it ever developed At the present time a larger project is contemplated on the Osage Ri er a hort distance from Jefferson City In recent years very little malaria has occurred in the basin of this water power project During a recent mosquito survey how ever a fairly h h proportion of quadrimaculatus mos quitoes were found This area is close to the Missouri River bottoms where localized outbreaks of malaria occur Just why the basin of the contemplated power project should be free has not been ascertained Work i g in coope at on with the United States Public Health Service we have made a prel minary study of the pos sibility of malaria in this area and have made recom mendations to the power company wh ch they are now ta ng steps to carry out

*Repo t from Member of Sub committee on Admini tration Nation l Mala ia Committe (Confer nc on Malaria) me t ng conjointly with Southern Medical Association Nineteenth Annual Meeting Dall Tex N v 9 1 19 5

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MALARIA CONTROL ACTIVITIES IN VIRGINIA*

By E G WILLIAMS M D
State Health Commissioner
Richmond Va

Fifty five per cent of the physicians of Virginia reported communicable diseases in 1922 in 1924 seventy nine per cent reported Although a greater percentage of physicians were reporting in 1924 than were reporting in 1922 the number of cases of malaria reported by physicians has gradually decreased

In conjunction with the above the malaria bureau commenced taking a school history index in nine counties for malaria with the hope that some correlation might be found between the two methods of measuring malaria Last year the following was stated The reporting of malaria by local physicians and the discovery of foci by county health officers has checked so favorably with the school history index as to cause the malaria department to make this an annual activity The school history index taken for 1924 seems to shatter the hopes that some correlation might be found between the methods of measuring malaria namely by physicians reports and by the school history index I regret to report that no adequate yard stick has so far been found for measuring malaria in Virginia

Education—The educational program is being carried on by the county health officers by lectures fair exhibits distribution of literature newspaper publicity and moving pictures The malaria catechism is being used in the schools

MALARIA ACTIVITIES THROUGH THE COUNTY HEALTH DEPARTMENTS

Field Studies—As the field studies and investigations have not been completed by the county health officers for this season it is impossible to give complete data at this time The Russell method of identification of *Anopheles larvae is being used in all* investigations and surveys It has served to create a great er interest in malaria work by county health officers It is rapid interesting and saves much of the health officers time

Our continued observations and studies show the *Anopheles quad maculatus* to be the main malaria vector in Virginia

Pond Control—During the year the study of pond control has been continued and added to materially Fluctuation of ponds continues to bring substantially the same measure of control as the first seasons work indicated However it was found that in the larger ponds in the upper reaches of which the water shoaled very gradually that one lowering of the water level was insufficient Once or twice later in the season it was necessary again to lower the pond level This measure was found entirely successful removing new floatage accumulations and killing new water plants such as algae that started in the new shallows

Pond control has so far been secured largely through persuasion but a bill is now in preparation which it is confidently expected the legislature will pass requiring the control of Anopheles breeding in impounded waters both large and small in the malaria sections of Virginia The only other control measures used in rural communities are screening and the standard quinin treatment

Urban—New urban control and maintenance of control done in the past has continued rather successfully Only one town is known to have ceased maintenance and when later in the season a number of malaria cases appeared maintenance was very promptly resumed The methods used for town control remain the same drainage oil soaked sawdust screening paris green and the standard quinin treatment

Maintenance of old work and new mosquito control has been put under the supervision of the county health departments with general direction by the Malaria Bureau In counties without health departments the Malaria Bureau advises and recommends methods of control

All malaria activities in the State of Virginia are carried out through the county health departments under the direction of the Malaria Bureau except special investigations and surveys and recommendations made in counties which do not have full time county health departments and these are made by the Malaria Bureau

MALARIA PROGRAM FOR 19

(1) To secure legislative action for the control of impounded waters

(2) Locating of all impounded waters in the malaria sections of Virginia (of all sizes) and making malaria history indices of these sections This work will be done by the health officer in counties having county health departments and in the other sections by the Malaria Bureau

(3) Field station studies of specially selected places will be continued as a means of *holding* the interest of the health officer and the citizens in the counties having county health departments

(4) To secure better reporting of malaria through closer cooperation of the physician and health officers This is to be done by having the health officer become a member of the county medical society and act as its secretary

(5) To have a regular bi monthly meeting of the county boards of health and the securing of their endorsement and personal efforts to induce the physicians to report malaria cases promptly

(6) Urban mosquito control is to be continued as in previous years In rural work the only efforts will be for the control of the breeding of quadrimaculatus as our studies of 1925 have convinced us more than

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*R p rt f om M mber of S b Committe on Ad mi i t ti n N ti l Mala ia Committ (C f e o Mal i) m ti g co j i tl with South rn Medical A sociation N t th A n al M eting Dallas T N v 9 19 5

Some of our county health officers are making spleen examinations a part of the routine medical examination of school children. The most difficult phase of malaria control work appears to us to be to arouse the sincere interest of the county health officer in malaria control work. The tendency is for him to minimize the malaria problem and to devote his time to other health problems which are more easily solved and render more spectacular results, results which will have a news value which he can use in advertising his health department to the politicians who control the purse strings. It is unfortunate that this condition exists but it is a reality that must be considered.

The next most difficult work we have is to interest the county inspector in malaria control work, having failed to interest the county health officer. In those counties where the inspector is a part of the health unit this has been accomplished by sending him to the International Health Board field station for a few weeks training. This has proved very valuable, but because of the lack of funds to pay the inspector's expenses it cannot be extensively employed.

We have endeavored to exercise supervision over impounded water projects so as to minimize the increase of malaria in the vicinity of such projects. Regulations adopted by our board last year are similar to those adopted by other states and call for the clearing of the reservoir site before it is flooded. At a project now nearing completion in this state these operations will have cost the company nearly a half million dollars. This is nearly 10 per cent of the total cost of the hydro electric project. Our malaria investigators ought to find a cheaper method for controlling malaria because this method adds considerably to the total cost of developing electrical energy and tends to retard development of our natural resources as well as tend to increase the rates at which electrical energy can be sold to the public.

We have completed malaria control projects at some new towns in the state this year and have exercised supervision over the maintenance work at towns where work was undertaken in previous years.

An interesting side light of the mosquito situation this year occurred in the plague of pestiferous mosquitos that invaded a number of towns principally in the Piedmont section of the state. Most of these mosquitoes were *Culex quinquefasciatus*, a variety of Culex that breeds very profusely in sewage contaminated waters. In two cities in the state the city health officer was almost obliged to leave town because of the flood of complaints that reached his office.

The figures we have collected on malaria prevalence since March through our weekly system of reporting by physicians indicates that physicians in our state saw at least 11,000 cases of malaria between March 1 and October 31. During the same period physicians reported 66 deaths from malaria, making one death to 167 cases. We do not know what percentage of malaria cases are seen by physicians. In malarious sections the percentage is smaller than it is in sections which are not so malarious.

We feel that our biggest problem is to interest the county health officer and the county inspector in malaria control work. Malaria deaths have been decreasing consistently from 312 in 1926 to 119 last year. The number for 1925 promises to be lower than last year, only [illegible] having been reported up to October 1.

MALARIA CONTROL ACTIVITIES IN TENNESSEE*

By E. L. Bishop, M. D.,
State Health Officer,
Nashville, Tenn.

Malaria control operations have been made a major element in the program of two full time county health departments. In Gibson county considerable information as to local foci has been secured by questionnaire surveys of school children and by the spleen index. Control operations consist of supervision of agricultural drainage, five thousand yards of ditching having been blown during the year; supervision of highway construction; the use of fish and the use of the standard quinin treatment.

In the other county, Obion, the principal activity has been devoted to mosquito control operations in the municipalities and to study of the problem about Reelfoot Lake.

The report of activity by the Division of Sanitary Engineering may be summarized as follow:

During the year the Division made complete preliminary surveys with estimates of cost and gave complete detailed instructions in verbal and written form for malaria control and mosquito eradication for the cities of Lebanon, Ripley, Chattanooga, Gallatin and Cookeville. The above surveys were made for new work. The latter three cities undertook the mosquito eradication and the Division was very much pleased with the results obtained. A description of the activities by Cookeville will be given in another paragraph.

The Division of Sanitary Engineering also made surveys for the successful continuance of this work at Columbia, Covington, Cowan, Dyersburg, Murfreesboro, Union City and Brownsville. All of these cities during the past year did malaria control work; the cities of Jackson and Memphis also did malaria control work, Memphis having its own sanitary engineer employed.

Tennessee experienced its first malaria epidemic due to impounded waters this year. This was near Cookeville, where the city had installed a municipal hydro electric plant, damming up water in the Falling Water River for some three miles. Case histories, symptoms and blood smears authentically confirmed the malaria. A complete sanitary survey was made by the Division of Sanitary Engineering in cooperation with the U. S. P. H. S. and the city immediately started control work. The lake was cleared of floating logs and other floating debris, the shore lines were partially cleaned of brush and grass and the shore lines not thus cleaned were sprayed with oil. The spraying was done from boats and knapsack sprayers were used.

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(5) To have a regular bi monthly meeting of the county boards of health and the securing of their endorsement and personal efforts to induce the physicians to report malaria cases promptly

(6) Urban mosquito control is to be continued as in previous years In rural work the only efforts will be for the control of the breeding of quadrimaculatus as our studies of 1925 have convinced us more than

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ever that quadrimaculatus is the only malaria carrying mosquito of importance in Virginia

(7) Educational work will be continued through the schools and by lectures exhibits distribution of literature newspaper publicity and moving pictures

MALARIA CONTROL ACTIVITIES IN TEXAS*

By H O SAPPINGTON M D
State Health Officer
Austin, Tex

This past year witnessed an increase in the interests of malaria control on the part of the Texas population and increasing activities in the control of the disease carrying mosquito on the part of the incorporated towns and cities of this State More than 103 cities in Texas adopted the malaria control program of which approximately 50 per cent secured good results while in the remaining towns the work was executed more or less sporadically

The population in the urban districts protected was 923 700 at a cost of $49 440 00 paid by the communities or a per capita cost of six cents There were 11 full time inspectors employed by the cities and 67 part time inspectors employed by as many cities

The State Board of Health had one malaria engineer in charge of this work and three district engineers who gave part of their time to the work while during the summer season four medical students were employed to assist in the supervision work in the various towns The amount of money expended on this work by the state was as follows

By State Appropriation	$10 000 00
From other sources	3 000 00
	$13 000 00

Work in the rural districts was carried on by a full time inspector financed in Caldwell County and by the full time county unit in Hidalgo and Falls Counties The State Board of Health was interested in assisting and securing the drainage of some 14 000 acres of land in the Trinity River bottoms and interested the State Game Fish and Oyster Commission to propagate gambusia affinis minnows for distribution to municipal hatcheries The Cotton Belt Railroad carried on its regular routine mosquito program in some fifteen towns along its Texas lines as in former years The Rock Island has also taken the initiative along this line The enactment of mosquito ordinances by twelve municipalities was obtained during the year

Malaria cases reported to the State Board of Health are as follow

The last eight months of	1920	48 115 cases
The year of	1921	49,256 cases
The year of	1922	35,584 cases
The year of	1923	21,268 cases
The year of	1924	16 068 cases
The first nine months of	1925	9,299 cases

These reports are obtained by mailing out cards to the physicians in the malaria belt on the first of each month and it is noted that better responses in reporting are obtained from the physicians each year It is estimated that at the present time approximately 35 per cent of the cases are reported.

Deaths from malaria that have been reported are as follows

The year of 1920	528 deaths
The year of 1921	523 deaths
The year of 1922	290 deaths
The year of 1923	160 deaths
The year of 1924	141 deaths
The year of 1925	191 deaths

EDUCATIONAL ACTIVITIES

The State Board of Health sponsored a short school for Sanitarians at which time inspectors and health workers were given instructions on identification and control of mosquitoes The State Board of Health interested the A and M College to offer a course in sanitary engineering including in that course the study of Hardenburg's book Mosquito Eradication" and lectures on mosquito control The Trinity River Reclamation and Conservation District has been organized embracing representatives of 40 cities and 34 counties along the Trinity River which organization has for one of its purposes the drainage of some 700 000 acres of land subject to overflow along the Trinity River and making this area more habitable for man and minimizing the malaria menace

Thirty six tourist camps have been approved by the Texas State Board of Health and it is one of the requirements for approval that the tourist camp be free from mosquito breeding places

Approximately 50 lectures on mosquito control were given 40 news items prepared issued and printed the mosquito film was shown 20 times a thousand or more letters were written on the subject and approximately 20 000 pieces of literature and placards were distributed

In addition to the above work the mosquito control activities with reference to yellow fever control carried on along the Mexican border cooperatively by the U S Public Health Service the Texas State Board of Health and border communities are not included

The excellent results secured in the past season are partially due to the unusually dry weather in some of our heavily infected malaria counties

*Report from Memb r of Sub Committ on Administration National Mala ia C mmittee (C nf e on Malaria) meeting conjointly with Southern M dical As o iation N te nth Annual Me ting D lla Tex Nov 9 1 19 5

MALARIA MOSQUITO CONTROL IN ILLINOIS*

By ISAAC D RAWLINGS M S M D
Director Illinois Department of Public Health
Springfield Ill

Organization—Malaria control activities are carried on subject to the Director's approval by the Division of Sanitary Engineering Two assistant engineers were assigned part time to the work which required approximately the equivalent of one engineer's full time for 12 months One engineer was stationed at Carbondale in the malaria belt to exercise close supervision over the work

Review of Malaria and Mosquito Control Activities Visits and surveys made at the following places (The number following the place indicates the number of visits made)

Belleville	4	Fairfield	1	Marion	1
Carbondale	23	Glencoe	4	Murphysboro	34
DeKalb	1	Gorham	15	Ravinia Park	7
DeSoto	1	Herrin	9	W Frankfort	24
Dowell	1	Johnston City	1	Winnetka	4

Conferences were held relative to control work at the following places (The number following the place indicates the number of conferences held)

Chicago Sanitary District	1	Highland Park	1
North Shore	1	Ravinia Park	3
Evanston	2	Herrin	4
DesPlaines River Area	1	Murphysboro	1
Glencoe	2	Winnetka	4

Sixty letters were written relative to malaria and mosquito control

Educational Measures—Addresses were made in public schools in towns where malaria projects were in progress Newspaper publicity was secured and house to house canvasses were made in towns carrying on control work Two pamphlets on Mosquitoes and Malaria were prepared and are being distributed to interested persons

Prevalence of Malaria—An average of 80 deaths from malaria occur annually in Illinois 60 per cent of which occur in the southern 12 counties which represent only about 5 per cent of the total population of the state Malaria cases and deaths are supposed to be reported to the Department of Public Health but case reports are very incomplete and give no index of the incidence of malaria Case rates from 2 to 6 per cent of the population are common in many southern Illinois cities

Control Projects—Control of rural malaria or malaria control on county wide basis has not yet been undertaken Jackson county where 50 per cent of the population has been actually served by malaria control projects will probably be the first county where such work may be taken up on a county wide basis All control projects thus far supervised have been demonstrational projects A list of the projects in progress during 1925 and data applying thereto is given below

The state ordinarily does not subsidize or finance control projects However in 1925 a special appropriation of $500 000 was made for the relief of southern Illinois tornado sufferers and a portion of this money was secured for carrying on malaria control at Murphysboro West Frankfort and Gorham

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*Read before Members of Sub Committee on Administration National Malaria Committee (Conference on Malaria) Meeting conjointly with Southern Medical Association Nineteenth Annual Meeting Dallas Tex Nov 9 1 19 5

SYMPOSIUM ON MALARIA

Papers and Reports Presented at the Conference of the National Malaria Committee, Meeting Conjointly with the Southern Medical Association, at Atlanta, Georgia, November 15-18, 1926

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SYMPOSIUM ON MALARIA

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Pages 460 49

THE PLACE OF MALARIA AS A HEALTH PROBLEM*

By Hugh S Cumming M D
Surgeon General U S Public Health Service
Washington D C

In addressing a body like the National Malaria Committee I realize fully the privilege which I enjoy the opportunity which is offered and the responsibility which is implied I am aware that the membership of this Committee includes persons of very diverse outlook but all united in the common purpose of getting rid of malaria It has become increasingly evident that if this purpose is to be achieved and I believe that this is only a matter of time the services of people of many different viewpoints must be requisitioned We shall need the zeal of the altruist the business sense of the man of affairs the foresight of the statesman the researches of a whole category of scientists the hard work of health officers and other administrators and the intelligent support of the public if we are to reach our goal within a reasonable minimum of time and without undue waste of effort and resources

It is impossible in dealing with so complicated a subject for any one person to make a strong or a well informed appeal to all of the interests involved In fact I feel that even a comprehensive confession of ignorance concerning many of the details would be a considerable undertaking I shall therefore try to stick to my last and discuss malaria from the standpoint of one who on account of the nature of his duties is expected to preserve a perspective view if not a detailed picture of the diseases and conditions which form the composite problem of public health

Malaria of course means different things to different peoples according to their environment In its most virulent and concentrated prevalence it means literally the impossibility of continued or permanent human occupation of a territory In a milder concentration it has the perhaps even more disastrous effect of permitting human existence while precluding the possibility of human health or happiness In the forms and prevalence which we customarily encounter in the United States at the present time malaria seldom presents these extreme menaces to the human race It permits some of the people to be in comparatively good health most of the time while crippling many others for much of the time its cultural effect being to hinder concerted progressive effort on the part of populations and to prevent their participating in the movement of racial advancement which should be their birthright One of the most important activities in this forward movement is public health It is the dictum of students of community health programs that these should be comprehensive well rounded out that none of the recognized effective measures should be ignored It is further maintained that a lop-sided health program which concentrates upon one activity and ignores others is in its last effect worse than none chiefly for reasons of mass psychology and public economics But where I should like to ask can you find a community where malaria is a serious factor in which a locally supported well rounded health program is possible? If such exist they must enjoy unusual economic freedom In general I think the statement is true that a seriously malaria ridden population is incapable unaided of maintaining a well balanced health program The obvious indication is to get rid of the malaria first put the community on a par with others which fortunately do not suffer this handicap and then proceed with normal development in affairs of health and of economic and cultural development

It was not my purpose in this discussion to make odious comparisons between malaria and other diseases which claim our attention I do not intend to decide which is the worst malaria or heart disease tuberculosis cancer or pneumonia In addition to the opinion which I have already expressed to the effect that malaria where it seriously prevail must be effectually combated before we can expect much progress against the multitude of other health problems I have indeed but two comparisons to make One of these is positive We already know how

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*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta Georgia Nov 15 1926

to prevent malaria much better than we know how to prevent the other major infections which continue insistently to claim attention This can only now be said in this day when plague small pox cholera yellow fever typhus and typhoid fever have become practically preventable

The eradication of malaria is now only a matter of refinements in economy the question of how to make effective measures cheap enough for local adoption and maintenance All the more reason that we should make a clean job of an undertaking so nearly completed The other comparison I must put in the form of a question Is there not some evidence which might lead us to expect something in the nature of a Mills Reincke phenomenon as one result of the elimination of malaria? The mechanism need not for the present detain us whether this result is to be predicted on the basis of increased bodily resistance to other infections or through the dispelling of ignorance and the alleviation of poverty But is there not evidence in fact that the general health of populations improves after the conquest of malaria?

I am quite aware that in saying get rid of malaria I am proposing a difficult accomplishment Past successes however justify the prediction that means will be found of solving the remaining problems We look to activities such as this Association is interested in activities of organization of coordination of research and of training to provide the ways and means of ridding us of this obstacle this stumbling block to progress in other health interests and we know that we do not look in vain

I shall listen with great interest to your expert discussions of the technic of your subject Such questions as the following come to the attention of even the casual student

Is it the mosquito in the pool or the mosquito in the house that we are after? Is quinine ever useful in the control of malaria and if so when and how? What do we actually know about clinical malaria? What species of mosquitoes are practically significant? Can the problem of the pest mosquito and that of the disease carrying mosquito be practically separated? Under what conditions may a population rid itself of malaria and when is outside aid necessary?"

We know of various sections in different parts of the world from which malaria has disappeared despite the fact that conditions have apparently remained the same the population has not changed in character and malaria bearing mosquitoes persist I recall that Sir William Osler alluded to this phenomenon with particular reference to large areas in the province of Ontario, which he had known as a boy I recall that Dr Hackett of the International Health Board told me that he has run across districts in Italy in which every condition favorable to the propagation of malaria existed and to which infection was being constantly brought by people from the provinces and yet the disease did not take a foothold These are problems well worthy of our continued and serious study

I should like to carry away the answers to these and other questions in my pocket, but failing this I know that my attendance here will bring me inspiration and useful information as is bound to be the case where earnest and able people deliberate under the guidance of science

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DISCUSSION (Abstract)

Dr Frederick L Hoffman Wellesley Hills Mass—It seems to me that the most important aspect of the malaria problem in this country concerns the detecting of persistent centers of the disease and precise delineation of the most intensely infected areas Information of this nature should be presented annually at our meetings to draw the attention of the public to the record that requires to be corrected I am not familiar with present day conditions in southeastern Missouri or with the improvements that have been made in the Yazoo Delta It would make a most useful contribution to our knowledge if some one annually would collect the mortality data for specific sections so that it may be clearly indicated where the black spots are on our map that remain to be eliminated The communities concerned may be relied upon to correct matters if they are aware that the infection is generally known

Dr S W Welch Montgomery Ala—Dr Hoffman's suggestion is very opportune indeed Some years ago Dr Maxcy of the United States Public Health Service was assigned to work with the State Board of Health of Alabama and he made a map of the United States showing where the malaria existed That map has not been revised There are many places in the Southern states now where there is not so much malaria as there was at that time A study of the question at least every two years since situations do not change by year as a rule and making of the map by some member of the Service would be a most valuable addition to our knowledge of the progress we are making in malaria control A number of places black on the map for Alabama at the time that the map was made are not so now We have made progress through the aid of the Service and the International Health Board The question of determination of the areas in which malaria exists is one of the first steps in its control But it is strange that after we know where the malaria is and how to control it it stays with us so long

Mr J A LePrince Memphis Tenn—The Surgeon General called attention in his paper to the fact that malaria campaigns have been the means of bringing into existence one third of the full time health units recently installed in thirteen states which is of decided importance

Dr A H Hayden Columbia S C—Treatment of malaria by x radiation of the spleen followed by cure

when all other treatment had failed was reported some time ago and struck me very forcibly I should like to ask whether any of you has had experience with this method

Dr C W Garrison Little Rock Ark—I cannot say like Dr Welch that we have cleared up our black spots in Arkansas It seems we have cleared up to some extent the light spots

The publications sent out on malaria control from various sources almost all end by saying malaria can be controlled at a very small cost We should bring the people of the South to the realization of the fact that the problem is a big one that malaria is prevalent and requires the combined resources of all to get rid of it We can control malaria at a minimum cost in certain selected areas but when we strike the black spots it takes money and it is a big and serious problem It requires a great deal of money to combat it on a large scale as has been done by the Department of Health of Alabama

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PROVISIONAL OUTLINE FOR FUNDAMENTAL DATA COLLECTED IN A MALARIA SURVEY*

By Mark F Boyd M D **
Edenton N C

The number of malaria surveys that have been made in the United States is in proportion to the attention that has been given to malaria control operations disappointingly small In view of this disparity neither the indications for or the results achieved by many control programs can be formulated Furthermore this inattention to surveys has let slip many excellent opportunities for the collection of data that will elucidate many of the phenomena of malaria epidemiology in the United States

The value of the surveys accomplished has been diminished because of the dissimilarity in the investigational procedure followed by different surveyors Any given procedure followed in consecutive years in any one locality would doubtless afford a fair indication of the trend of malaria incidence in that locality On the other hand the diversity of practice prevents us from making safe and reliable comparisons of the degree of endemicity prevailing in different areas a difficulty which we believe could be largely eliminated if the different surveyors would follow a uniform procedure

In view of this situation to attempt to outline provisionally what should constitute the basic data to be gathered in an investigation of this character and the analyses to which it should be subjected in order to elucidate the epidemiological situation prevailing appears a worthwhile undertaking The provisional outline herewith presented is submitted with the hope that the attention of malariologists will be attracted to the situation and that through the agency of this Committee an opportunity may be provided for the development of an outline that will meet with general approval and consequently be widely adopted

Reconnaissances and Surveys—These differ in scope and the intensity of the investigation

(1) *Reconnaissances*—By these are meant rapid investigations covering broad geographical areas made to define the limits of the distribution of malaria but without undertaking to determine the character of the malaria problem in any part of the general area Their purpose is adequately fulfilled by the examination of children for splenomegaly They can be satisfactorily accomplished at any season of the year The observations may be made wherever people are congregated (schools) while the data may be handled similarly to the data of surveys

(2) *Surveys*—These are intensive investigations carried out in circumscribed areas known to be malarious to define the character of a malaria problem preliminary to the preparation of a control project The scope of the survey should include an adequate investigation of anophelines The fundamental facts to be elicited by the inquiry relating to the incidence of the disease are the following

(1) The local geographical distribution of malaria
(2) The degree of endemicity usually prevailing
(3) The extent of transmission (usual endemic conditions or extraordinary epidemic conditions) which prevails or prevailed in the most recent season

These facts cannot be altogether directly elicited but are indirectly inferred from the data collected The data required are objective rather than subjective in character Hence the latter such as fever histories are subordinate and may be omitted without an essential sacrifice The data for a survey should be collected by a house-to-house canvass

(3) *Sampling*—Since observations will be made on a sample taken at random from the entire area the question of what constitutes an adequate and representative sample must be given careful consideration The surveyor will require the data of the most recent census to

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*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta, Georgia November 1[illegible] 1926

**International Health Board.

learn the total population and its racial distribution in the area. Initial plans should be made to examine at least one tenth of the total population appropriately distributed according to age, and the results should be tentatively observed and compared with the table of probable error given by Pearl ("Biometry and Vital Statistics"). If the probable error is high as may be expected with initial results of 50 per cent positives, the sample should be increased until the probable error is diminished to a satisfactory figure.

If reliable census figures are not available the surveyor will be compelled either to make his own enumeration or an estimate of the population, preferably on the number of occupied houses.

(4) *Mapping*.—A fairly accurate map of the area on which all data can be localized is indispensable. If accurate maps are not available they may be constructed by the surveyor following the directions given by Hulse (*American Journal of Public Health*). The area should be conveniently subdivided so that comparisons of local intensity may be made.

(5) *Field Work*.—This consists in the examination of the individuals that compose the sample. Examinations consist in determining the existence of splenomegaly and its degree and the collection of a blood smear together with the necessary identificatory data. The individuals should be selected for the sample without regard to a history of malaria. It is essential that the blood and spleen data be simultaneously gathered from the same individuals. This is not done with the idea of using one to corroborate the other but in view of the fact that they are complementary procedures. The essential data are the following:

(1) Name	(5) Place of residence
(2) Age	(6) Length of residence
(3) Sex	(7) Size of spleen
(4) Race	(8) Results of blood examination

In accordance with the exigencies of proper sampling individuals of all ages, all races and both sexes should be examined in the course of a survey. In the course of a reconnaissance limited to school children the age groups are necessarily limited.

The place of residence should be accurately fixed on the map. The dwellings occupied by the persons examined should be classified according to the degree of obstacles they afford to the entrance of mosquitoes.

(a) Spleen examinations should be made with the subject recumbent, the legs flexed, and splenic enlargement determined by palpation of the abdomen. Palpation should be accomplished by as delicate a touch as possible. Spleen sizes may be classified as follows:

(0) Not palpable.

(P.D.I.) Palpable only on deep inspiration.

(1) Enlarged extending to the costal margin.

(2) Enlarged margin somewhere between the costal margin and a point half way to the umbilicus.

(3) Enlarged margin somewhere between the lower limit of the preceding class and the umbilicus.

(4) Enlarged extending below the umbilicus.

It is felt that attempts to employ fewer groups, or to apply fixed units of measurement will, at present, not give desirable results.

(b) *Blood Examinations*.—The blood specimen shall be taken from the lobe of the ear after the first two or five drops exuding have been discarded. Thin or thick smears or if possible both should be made. Thin smears are examined routinely 15 minutes before reporting as negative and thick smears are to be examined for five minutes. The method of staining is optional providing the smears are well stained according to the technic employed. The smears collected should be protected from the ravages of flies and other insects and stained as soon as possible. Specific distinction should be made between the various species of parasites, both as trophozoites and gametocytes. If the examiner deems advisable *P. vivax* and *P. malariae* may be reported together as "large parasites" where thick films are employed. Delicate rings with several chromatin dots shall be classified as *P. falciparum*.

(6) *Minimal Analyses*.—The data should be handled in the following groups:

(a) Race.

(b) Age according to the following groups:

Under 1 year of age
From 1- 4 years of age
From 5- 9 years of age
From 10-14 years of age
From 15-19 years of age
From 20-39 years of age
40 and above

On the above basis the following minimal analyses are to be presented:

(a) The actual or estimated population.

(b) The actual number of individuals examined.

(c) The actual number of persons with different degrees of splenomegaly and the specific spleen rates for each group.

(d) The actual numbers of persons found harboring *P. falciparum* together with the specific rates for each group.

(e) The actual numbers of persons found harboring *P. vivax* together with the specific rates for each group.

(f) The actual numbers and rates for *P. malariae* except that where distinction from *vivax* is not made they shall be classified as "large parasites."

(g) The actual numbers of and per cent of those examined showing positive evidence of malaria.

(h) For each of the local subdivisions there should be given for all below 15 years of age and for all above 15 years of age as well as for all examined (1) the spleen rate, (2) the *falciparum* rate and (3) the *vivax* or large parasite rate.

(i) Separate tables should be presented giving the foregoing information presented according to length of residence as follows: (1) those under one year of residence (including newborn), (2) those from one to two years of residence and (3) those of three or more years residence.

Further analyses may be made as the ingenuity of the surveyor may suggest, but the report should not omit any of the foregoing. Data regarding subjective evidence such as clinical histories or the consumption of cinchona derivatives should be regarded as supplemental.

The spleen and parasite rates among people living in different types of houses should also be presented.

(7) *Anopheline Surveys.*—These are a coordinate part of an adequate malaria survey. They should be made in the season most favorable to anopheline propagation. They should be expected to yield the following minimal information:

(a) The determination of the local species and of their relative abundance.

(b) The determination of the local anopheline vectors.

(c) The determination of the local production areas of the vectors.

(8) *The Local Species.*—Collections of both larvae and adults should be made in all situations, the searcher being uninfluenced by any preconceived notions. Captures of adults may be both diurnal and nocturnal in character. The specimens should be specifically identified and the results by species considered according to:

(a) Type of breeding place.

(b) Type of shelter.

(c) Season.

(d) Density of individuals encountered in different situations.

All data should be geographically considered.

(9) *Local Vectors.*—The actual importance of the different species in the propagation of malaria can best be determined by the dissection of wild caught mosquitoes and their examination for the detection of malaria parasites. Specimens for dissection should be secured from areas where malaria is prevalent. The examination should include both stomach and glands, while the results should be considered from the standpoint of successful dissections of these organs. Inspection of the salivary glands should be considered the criterion necessary to implicate a species. The series dissected must be sufficiently extensive to give reliable results.

10. *Local Production Areas.*—Much information bearing on this point will be collected in the course of the determination of the local species. The need is rather for secure negative than positive data.

(11) *The Relation of the Malaria and Anopheline Surveys.*—The reliability of the conclusions deduced from the two surveys may be judged by the extent to which they are mutually corroborative. Especial consideration should be given to:

(a) The relation of the seasonal distribution of the species incriminated as the vector to the seasonal distribution of malaria.

(b) The relation between the local intensity of malaria and the location of the production areas of the incriminated anopheline.

(12) *The Economic Situation.*—The general economic condition of the area concerned may be expected to have a profound effect upon the nutrition and well being of its occupants, which must be recognized as important though ill defined factors affecting the malaria problem. It does not seem feasible, in view of our indefinite knowledge of their nature, to undertake to recommend routine procedures in the study of these factors, yet nevertheless they cannot be ignored in the investigation.

While adequate observations along the foregoing lines may be expected to yield sufficient information to make an epidemiological diagnosis, yet the surveyor must remember that the ulterior purpose of his work is to afford relief from an intolerable situation, in other words, to afford a basis on which epidemiological treatment may be prescribed.

DISCUSSION (Abstract)

Dr. M. A. Barber, Greenwood, Miss.—We cannot properly study any change in the amount of malaria in a community unless we have adequate data on the earlier and later conditions existing there. To illustrate, a community in the tropics showed a marked diminution in malaria following extensive drainage. During the period when malaria was abundant, extensive public works, attended by an influx of laborers, were being carried on. At the time of my residence in the com

learn the total population and its racial distribution in the area. Initial plans should be made to examine at least one tenth of the total population, appropriately distributed according to age, and the results should be tentatively observed and compared with the table of probable error given by Pearl ("Biometry and Vital Statistics"). If the probable error is high, as may be expected with initial results of 50 per cent positives, the sample should be increased until the probable error is diminished to a satisfactory figure.

If reliable census figures are not available, the surveyor will be compelled either to make his own enumeration or an estimate of the population, preferably on the number of occupied houses.

(4) *Mapping*.—A fairly accurate map of the area on which all data can be localized is indispensable. If accurate maps are not available they may be constructed by the surveyor, following the directions given by Hulse (*American Journal of Public Health*). The area should be conveniently subdivided so that comparisons of local intensity may be made.

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(1) Name	( ) Place of resid nce
( ) Age	(6) L ngth of e iden e
(3) x	( ) Siz of spl n
(4) Race	(8) Result of blood examination

In accordance with the exigencies of proper sampling, individuals of all ages, all races and both sexes should be examined in the course of a survey. In the course of a reconnaissance limited to school children, the age groups are necessarily limited.

The place of residence should be accurately fixed on the map. The dwellings occupied by the persons examined should be classified according to the degree of obstacles they afford to the entrance of mosquitoes.

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(1) Enlarged, extending to the costal margin.

(2) Enlarged, margin somewhere between the costal margin and a point half way to the umbilicus.

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It is felt that attempts to employ fewer groups, or to apply fixed units of measurement will, at present, not give desirable result.

(b) *Blood Examinations*.—The blood specimen shall be taken from the lobe of the ear after the first two or five drops exuding have been discarded. Thin or thick smears, or if possible both, should be made. Thin smears are examined routinely 15 minutes before reporting as negative, and thick smears are to be examined for five minutes. The method of staining is optional, providing the smears are well stained according to the technic employed. The smears collected should be protected from the ravages of flies and other insects, and stained as soon as possible. Specific distinction should be made between the various species of parasites, both as trophozoites and gametocytes. If the examiner deems advisable, *P vivax* and *P malariae* may be reported together as "large parasites" where thick films are employed. Delicate rings with several chromatin dots shall be classified as *P falciparum*.

(6) *Minimal Analyses*.—The data should be handled in the following groups:

(a) Race.

(b) Age, according to the following groups:

- Under 1 year of age
- From 1 4 years of age
- From 5 9 years of age
- From 10 14 years of age
- From 15 19 years of age
- From 20 39 years of age
- 40 and above

On the above basis the following minimal analyses are to be presented:

(a) The actual or estimated population.

(b) The actual number of individuals examined.

(c) The actual number of persons with different degrees of splenomegaly and the specific spleen rates for each group.

(d) The actual numbers of persons found harboring *P falciparum* together with the specific rates for each group.

stocked with 3 000 gallons or more on hand and closed the season some 2,800 gallons ahead

In the early part of the summer we had little difficulty in killing with the oil It did not spread any too well but as it cost us very little we put it on thick, and got by pretty well until July when two garbage dumps near the center of the City started very heavy production Both these dumps caught on fire and were flooded with water This started trouble Thereafter the dumps were on fire off and on for two months and hose lines were left in place on them and operated continuously Very foul water stood in pools and puddles on and around these dumps Culex throve in all these pools We flooded the dumps with oil with very little result For some reason the oil which worked fairly well in clear water had almost no larvacidal power in the black heavily fouled water In other places we had much the same experience In storm sewer outlets (which by the way gave us much trouble) where the water was clear our oil would kill in four to eight hours about 90 per cent of the larvae and all tumblers In dirty water the action was much less satisfactory I kept wigglers from a storm sewer outlet in a large flask in my office for two weeks with a heavy coating of our best waste oil over them Few hatched out but the oil did not appear to interfere with them in any other way

Following this we purchased some kerosene and added it to the waste oil in proportion of 25 to 50 per cent Even this did not work satisfactorily on heavily polluted water though it was an improvement over the straight waste oil We also used various compounds as creolin cresote and by product wastes having in mind something that would cut the oil make it spread and add to its killing power

We happened to have on hand some Kresol Dip No 1 that we had purchased for various purposes Noting how rapidly it spread over the surface of the water when applied in a thin spray our foreman Mr I F Givens tried mixing it with the oil The result was extremely satisfactory The waste motor oil when charged with Kresol Dip No 1 in the proportion of one pint of dip to 4 5 gallons of oil spreads very rapidly and kills all larvae and tumblers in ten to twenty five minutes in either clear or dirty water One effect of the Kresol mixture is to destroy or lessen the surface tension of the water thus causing the oil to spread rapidly and more important making it flow up and around grass stems and debris of all sorts When this mixture is used there is no trouble about getting killing results back to the very edge of the pools even when they are fringed heavily with grass

With the oil we were using the one pint to 4 5 gallon proportion worked very well A greater percentage of Kresol did not improve matters much With other oils a greater or less percentage may be best The least that will give results should be used

We mixed the Kresol in the sprayer as needed and used it only when we found larvae With our work stretched out as thin as it was we made a complete round of the City once in 15 days and oiled everything whether it was producing or not because the chances were it would be producing before we could get back again and we had no reserve to take care of such things It took good management to use the dip only when needed but as I have said our foreman was a most unusual one and he did it without any trouble

Oil mixed with Kresol No 1 did not seem to affect fish or animal life any more than straight oil It did appear to have somewhat greater effect on weeds and vegetation than oil alone We found no dead minnows or fish and had no complaints regarding poisoned animals

Our bill for kerosene and Kresol Dip for the summer was $76 25 We used about 40 gallons of dip at $1 25 p r gallon We collected nearly 16 000 gallons of oil at a total cost of 2 [illegible] cents a gallon delivered at our headquarters in 50 gallon drums Our total cost of collecting oil was $426 54 which includes time labor foreman and truck expense The oil and Kresol mixture cost us as you can figure approximately 5 75 cents a gallon and it was far better than any straight oil I have ever used

Approximately half our money went for oiling work The 14 000 gallons we put out cost us about 19 5 cents a gallon to distribute including all items The expenses of our campaign totalled $5 483 We did not obtain complete control of all mosquitoes but there was no production from any natural sources Practically all of our trouble came from artificial breeding places garbage dumps barrels basements holding water (these were worst) buildings under construction roof gutters and similar places This seems to be contrary to the experience at many of the places where mosquito control campaigns have been carried on

Our experience with waste motor oil was quite satisfactory and I should consider its use in any

munity the public works had been finished and the town had taken on the character of a settled community Much of the drainage had been completed but anopheles of a species known to be vectors of malaria were still present in considerable numbers Lacking data as to the numbers of anopheles before and after the ditching we are left in doubt as to whether the bulk of the change in malaria prevalence was due to the conscious antimalaria work or to the change in the character of the community

The details of the plan proposed by Dr Boyd have still to be worked out A standard method with too many requirements may defeat its own aim by encouraging the investigator to attempt more than he can do or have done accurately Time and means for an ideal survey are often lacking but in any case some dependable measurement of the malaria parasite rate and of the prevalence of adult anopheles is essential

Mr J A LePrince U S P H S Memphis Tenn—The reconnaissance surveys already made in our country were useful in locating centers of high malaria prevalence and in determining possibilities of control campaigns in the local areas visited

Malaria surveys of an intensive nature along special lines have been made by Barber Mayne and Maxcy The British have done much more intensive survey work on a large scale than we have but their work has not been as closely confined to malaria survey studies leading to the determination or devising of new better cheaper and quicker control measures as have the investigations of Americans

Dr Boyd brings out the fact that more uniform detail survey studies should be made and I hope in that connection the questions of malaria carrier of topographic changes minor climatic variations in cycles of time and variations of food values of anopheles and matters related thereto will be given due consideration

In connection with mapping the surveys could be expedited if soil survey maps were available for all counties in the malaria belt These maps show the location of all homes and water courses and would be available if the general public demand for them were increased

In connection with anopheline surveys I desire to urge the wider use of the anopheles traps for houses At Panama we used double flare traps as a practical control measure and they can be used in malaria surveys to make it easy to determine the percentage of anophelines entering houses that are infected and to furnish other data

The study of type of shelter is a very important subject about which but little specific knowledge is available There are strong indications that at times anopheles prefer man made shelters to natural ones but we have not yet capitalized this fact as an important potential control measure as we should do

Many investigators refer in a very vague way to economic conditions as an important item that affects the malaria problem and the malaria rate I mean aside from the screening of the home Can the existence of high malaria prevalence and its relation to local economic conditions be so specifically defined by malariologists that John Smith can understand what the statements mean? Thousands of pages of purely imaginative literature relative to conditions that spread disease have been given out in the past

If the majority of the people who go into or live in malaria districts were poor and we gave them double their present income what would they do that would decrease malaria prevalence?

Dr W L Holt Hot Springs Ark—I should like to ask Dr Boyd how he makes his spleen examinations of school children Can this be done in the rural schools by laying the children down on a table?

Dr Boyd (closing)—Our examinations of school children for splenomegaly are limited to boys and are made with the child in a recumbent position

I have nothing further to add except to express a hope that a subcommittee will be formed to consider the procedures to be followed in making malaria surveys and will succeed in developing an outline that will be generally accepted and adopted

USE OF WASTE OIL AS A LARVACIDE*

By W A HARDENBERGH **
Birmingham Ala

When early in 1926 the Department of Health of Birmingham decided to put on an anti mosquito campaign we were faced with the necessity of utmost economy Our preliminary plan called for an expenditure not to exceed $6 000 maximum while it was the intention to limit this expenditure to $5 000 if possible For a city of 225 000 population covering 50 square miles or 30 000 acres this meant economy to a considerable degree

Our estimate called for the use of 12 000 gallons of oil for an average year with a 20 per cent leeway over or under depending on the weather As a matter of fact it was a very wet summer and we used almost exactly 14 000 gallons At the market price of oil in Birmingham 10 to 14 cents per gallon depending upon the quality the purchase of oil would here made a very serious cut in our available money I heard that Mr Stromquist in Memphis had been using waste oil so I visited him and as a result we decided to use waste motor oil

The details of how we collected it are of little interest In few places will there be any real difficulty in obtaining all that is needed for the work if there is proper management and planning We accumulated a small reserve early in the spring and thereafter had no worries on the matter due largely to the services of the best oiling foreman I have ever seen a former inspector of the department who was transferred temporarily to this work We were always

*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta Georgia November 15 18 1926

**Sanitary Engineer Department of Health

Mr. Hardenbergh has just told us of his experience early in the season when his waste crank case oil used by itself killed larvae readily but lost its killing power later in the season. In the spring and early summer when the mornings are cool and automobiles hard to start, drivers of machines use the choke freely. This floods the cylinders with gasoline, much of which leaks by the rings and gets into the crank case. Hence crank case oil collected in cool weather contains a fair proportion of gasoline and makes a rather good larvacide. As the summer grows warmer this gasoline dilution is for the most part lost and the crank case oil loses its power to kill.

Mr. Hardenbergh gives as his oiling period once every fifteen days. This will be sufficiently frequent during prolonged dry seasons. However, this period will have to be considerably shortened during a rainy summer. When rains fill temporary pools we get certain *Aedes* and *Psorophora* which breed heavily in temporary puddles. A short water stage is characteristic of these temporary pool breeders and many of them are in the water stage for not over five days. Under these circumstances the fifteen day oiling period must be reduced to five.

Crank case oil finds its main use as a diluent of the more toxic volatile oil. There is another side to the problem, that is, concentration. It is possible to develop an aerial attack, that is, oil marshes by aeroplane. Under these circumstances the most concentrated toxic agent must be used. Dr. B. S. Cook, M.C., U.S.N., and I carried on a few such experiments late last summer, the results of which seemed to indicate that the procedure is feasible. We put a tank in the after cockpit of the photographic machine at Quantico, Virginia, ran a two inch pipe to the rear of the fuselage and allowed the oil to flow freely into the air blast of the propeller just below the rudder of the machine. With the plane flying at heights of fifty and twenty five feet and at a speed of about seventy miles per hour, the oil was broken up into a beautiful mistlike spray and fell to the earth in a fairly even path about 150 feet wide. However, with the kerosene used and the slow speed of delivery, we found that we were only applying one sixth of a gallon of oil per acre. That was too small a quantity to kill larvae. We have not as yet determined how much oil will be necessary per acre, but it is probably considerably in excess of this figure, for Griffitts, when applying oil as a mist under heavy air pressure, applied approximately two and a half gallons to the acre, and Mr. Clarkson tells me that in Georgia during the past season on a large impounded water project they applied oil by Griffitts' method and found it necessary to use three gallons per acre.

Dr. John H. Hamilton, Wilmington, N. C.—Crank case oil is variable. Some is effective and some is not, and we have come to the same conclusion in regard to kerosene. Some of the best looking oil is least effective as a larvacide.

Mr. Hardenbergh (closing).—I do not remember that I said five cents per acre or per person. Either is wrong. The cost was about two cents per capita or fifteen cents per acre, skyscrapers and all. We do not oil skyscrapers, but we have a lot of land not covered by skyscrapers. We found certain areas which held water longer than others and soon after we observed these I put a truck in service to take care of them. I am interested in Dr. Williams' explanation of why the oil worked better at one time of the year than at the other. I did not work that out.

MALARIA PROBLEM IN MEXICO*

By Frederick L. Hoffman
Wellesley Hills, Mass.

My views regarding the malaria situation in Mexico are based on some recent extended investigations made on the west coast of Mexico from Mazatlan to Ixtlan and on the east coast, chiefly in Vera Cruz, the States of Yucatan and Campeche, and on the Isthmus of Tehuantepec. My general impressions may be summarized in the statement that the malaria problem is now of less significance than in former years, but the disease still prevails to an extent in certain sections and certain localities, regarding which, however, very definite data are at present unavailable. In the course of time this paper will be amplified by official statistics for different states and sections which will afford at least an approximate basis of judgment concerning a situation which unquestionably demands attention.

The guide book of Mexico contains numerous references to localities where health conditions are referred to as dangerous, and invariably chiefly on the basis of the climate. The climate, of course, has very little to do with the matter other than that a warm atmosphere increases parasitic life and the prevalence of mosquitoes. As a further illustration, the Standard Guide to Mexico refers to Campeche as a decidedly undesirable locality. I was in Campeche for several days and learned nothing that was particularly alarming.

Likewise many writers charge Vera Cruz with suffering from an overwhelming pest of mosquitoes. I was in Vera Cruz on two occasions for several days. I slept with open windows and suffered no serious discomfort. I mention these illustrations of the effect of reasoning from past conditions which are almost without exception in marked contrast to the present situation. Anopheles are widely distributed over Mexico, but no accurate survey has been made. There is the utmost need for a number of local surveys, which, however, should be made only by those competent for the purpose.

Another need in Mexico is the proper tabulation and qualified analysis of the local mortality statistics. These are kept in antiquated form, but with reasonable accuracy and completeness.

*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twentieth Annual Meeting, Atlanta, Georgia, November 15-18, 1926.

place where it could be obtained The collection of the oil is a fairly good means of advertising the work The economy real or apparent, in the use of this oil as compared to the purchase of unused oil is manifest to all and tends to please that portion of the populace who feel that boy scouts and volunteer workers are sufficient for any anti mosquito campaign In other words there are few real disadvantages to its use while there are some real and many plausible reasons for using it

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DISCUSSION (Abstract)

Dr James A Hayne Columbia S C—I would very much hesitate to go into any community in South Carolina and try to get rid of the mosquitoes for five cents an acre There is not much acreage in Birmingham It is all skyscrapers Per capita cost always stands out in my mind as the most valuable index In Bamburg a town of 2 100 it cost $30 000 to get rid of malaria but the malaria is gone It cost $15 per capita We had about 90 per cent malaria but now we have none and it was worth the money

Mr E G Stromquist Memphis Tenn—Since 1921 we have developed the system of collecting waste oil in Memphis so that since 1923 we have purchased no oil for our mosquito work The oil is put into steel drums at the garages and filling stations and is kept free from cotton waste and other material so that it needs no special straining We use 16 000 to 18 000 gallons per season applying a heavier film than formerly when our oil was more expensive The cost of collection i e labor and truck maintenance is 2 5 to 3 5 cents per gallon

The cooperation of the Fire Marshal has made the system possible and placed the Department of Health in a position of doing rather than receiving a favor

Occasionally we get some thick oil which does not spread well Next year we plan to try mixing a little gas oil with the waste oil when it is too thick

Mr H G Tuggle Memphis Tenn—Some of the counties of the North Atlantic States do all of the mosquito control work in the villages and rural sections of the county County funds are thus used for control of pestiferous mosquitoes Possibly it is only a question of time before we shall use a similar procedure in the Southern States So far as I am aware Shelby County in western Tennessee is the only county in the South that is carrying on and paying for Anopheles control measures by oiling or otherwise treating all Anopheles breeding places near all villages and towns in the rural sections of the county This work has been done for several years under the direction of the County Commissioner of Health

In addition to controlling an area of thirty five square miles surrounding the city limits of Memphis we oil for Anopheles control at twenty one villages or small towns in the County The total County area under intensive control by oiling ditching Paris green and by the use of top minnows is approximately one hundred and twenty five square miles The three villages farthest from headquarters are thirty twenty eight and twenty six miles away

At present the County owns and operates two auto trucks for transportation of oil and for oiling purposes Two foremen and two crews (five men to the crew) of laborers are kept busy distributing and applying oil in the controlled areas

To care for the Anopheles control at the twenty one villages and towns and the area surrounding the city limits of Memphis we collected about 55 000 gallons of crude or waste oils and used about 45 000 gallons This oil cost us 1 6 cents per gallon or $880 to collect and store and 7 2 cents per gallon to deliver and place on the water surface in and near the towns and villages

Several years ago some sick cattle died and the owner got the impression that this was due to the presence of crude oil on their drinking water and took the case to court If the County had used toxic mixtures in their oil they would have had to prove it was not poisonous or pay for the cattle I understand that they had oil troubles at Panama about twenty years ago and to prevent the oil from being washed away they added to their oil a locally made larvicide equivalent to the cattle dip mentioned by Mr Hardenbergh This preparation cost them from twelve to eighteen cents per gallon to make I have made and used the same larvicide as that used in the Panama Canal Zone and found that it cost me forty five cents per gallon In our oiling of sewage charged streams we mixed 1 per cent of this preparation with our mosquito oil and found it to be efficient in breaking the surface tension and also furnishing the required toxicity to our waste oils for mosquito control

Possibly we are all familiar more or less with the rapid disappearance of oils from the surface of streams that receive sewage and some other waste products Dr Willem Rudolfs biochemist at the New Jersey Experiment Station presented a very interesting paper on this subject at the New Jersey Mosquito Extermination Association Meeting held last February in New Brunswick New Jersey It seems from his report that the best procedure would be to determine chemically the presence of soluble carbohydrates and when these are found to use some bactericide or larvicide to overcome the condition produced by the gas in sewage polluted streams

I am very glad that Mr Hardenbergh brought out the need of more effective treatment of polluted water for though the automobile industry reduces the price of the oil we use it also causes more families to live out of town to install more septic tanks to pollute more streams and thus create more scattered battlefields for the mosquito control forces

Mr Hardenbergh's figures indicate that forty one persons received considerable relief for each dollar spent or a total cost of about 12 5 cents per family per year Or it costs two cents per family per month for the pleasure of being able to sit out on the porch on hot nights without continuous slapping Unquestionably this means that the work was well planned and supervised

Dr L L Williams Jr Richmond Va—The larvacidal toxicity of oil increases with its volatility To produce larval deaths with pure engine oil a very thick film is necessary which must remain unbroken for at least two days Pure kerosene in summer temperatures in the South kills larvae in twenty minutes or less As applied from a spray can two or three times the lethal dose is applied to any given body of water Waste crank case oil was first used to minimize this waste Kerosene was diluted with the waste oil in a fifty fifty mixture thus saving half the kerosene

country by which general paralysis and other mental diseases can be treated is an arrangement for giving malaria by the bites of infected mosquitoes instead of by direct blood inoculation

It seems to be very well worth while to give this statement a wider currency in view of the high authority which stands behind it

I also quote from Dr James report another significant statement to the effect that the result of his recent observations

indicate how small is the chance that a particular breed of malaria carrying mosquitoes in nature will ever be concerned in transmitting *the disease It is probable* that at least 95 per cent of the potential malaria carrying mosquitoes which emerge from the larvae stage in nature will never play that role which is reserved for a few individuals whose life will be passed in a manner very different from that of the remainder of the brood This conclusion is forced upon us when we consider how difficult it is under the most favorable conditions to bring even a few members of a large brood of mosquitoes to a condition in which they will be successful *transmitters of malaria*

He therefore concludes

that in nature the only mosquitoes which succeed in transmitting malaria are those rare individuals who happen to pass their life in conditions which resemble very closely those which we have found to be essential for the successful transmission of the disease in experimental work No one who fully appreciates the importance of this conclusion and accepts it as true can fail to regard anti mosquito measures for dealing with malaria from a point of view He will at least realize what a great waste of effort is involved in measures directed against one species

And finally the highly suggestive advice that

the secret of a successful control of malaria lies not in the general knowledge that the disease is spread by mosquitoes of a certain kind but in the particular and exact knowledge of the life history of the few individual mosquitoes which succeed in becoming transmitters of the disease

I regret that I cannot further enlarge upon the observations of Dr James who emphasizes phases of the subject which are generally ignored on the part of those who are concerned with the problem of mosquito control

I am able to give the following statistics for Vera Cruz *which cover the year 1925 There* were 2 661 deaths from all causes of which 166 or 6 2 per cent were from malaria This of course is a relatively high rate of incidence but it must be considered that *the medical diagnosis* in many cases was probably defective Still I do not question that malaria was common even though it may not have been the immediate cause of death For the male population the rate was 5 5 per cent and for the females 7 1 per cent which is rather contrary to the usual experience that there is a larger malaria mortality among males There were 47 deaths from typhoid fever in Vera Cruz

DISCUSSION (Abstract)

Mr J A LePrince U.S.P.H.S Memphis Tenn —I believe the malaria prevalence on the coastal lowlands of Mexico has considerable detrimental influence on the commerce between Mexico and the United State and that the completion of Dr Hoffman's investigation will show both a high malaria rate and pernicious type of malaria to be present in the coastal pla The topography rainfall and climate are suitable to such malaria prevalence and as late as several years or about 1922 the chief surgeons of the American oil interests operating between Tampico and Papantla proved to me that this was the case I lived in this oil field area for five months and found our friend *Anopheles quadrimaculatus common near Tampico In one place about sixty were* found in a dry barrel under a tree in the dry season Dr Alfredo Cuaron and Dr A Stubbs of Tampico will verify my statements relative to malaria prevalence which has played havoc with the labor situation in the past ten years

To some extent I can understand a relative reduction of pestiferous mosquitoes at Vera Cruz as the American army of temporary occupation about 1915 drained the mosquito producing places in and adjacent to the City *of Vera Cruz Col W D Wrightson now at Fort* Pierce Florida directed that control work

I do not believe the crudeness of the habitations is any more pronounced in relation to malaria in Mexico than it is in the malaria belt of the United States In both countries until recent years ideas relative to malaria transmission among the farm population were a hundred years old

It is probable that the health departments of most of the states of Mexico are doing as little toward malaria elimination as are many of the county health units in the malaria belt of the United States that is practically nothing

Much good can be done and should be done as Dr Hoffman suggests by the Pan American Sanitary Bureau which during the term of office of Surgeon General Cumming has translated into Spanish a number of bulletins of the United States Public Health Service relative to malaria Unfortunately they have omitted to translate the most important and useful message we Americans could send to Mexico which is an article published about seven years ago by Surgeon L D Fricks in *The Military Surgeon*

All American field workers would very much like to know what the Mexican Federal Public Health Service is doing toward malaria control and hope that information will be given when Dr Hoffman's paper is published

I have read the report of Dr James that Dr Hoffman refers to and desire to state that American malaria field workers reached these same conclusions more than fifteen years ago and our written reports on this subject show that we were applying these conclusions in a number of ways and places in our daily malaria control operations at that time The mere fact is recently pointed out in United States Public Health Service publications that our county health units could use these measures to advantage but are afraid to do so does not mean that all American field workers are asleep on the job and have missed the facts that Dr James has recently published If Gorgas had not seen fit to approve these method our additional labor turnover and labor inefficiency at Panama would have cost us many times over all that has been paid to date for malaria control in the United States

If any useful control measures are being ignored by all malaria field investigators in the United States I

except for the fact that in many localities medical attention is wanting and the reports represent the guesswork of laymen Much is called paludism that may or may not have been malaria

Housing conditions practically everywhere in Mexico on the part of the poor foster malaria infection There is almost universal neglect of surrounding conditions which give rise to parasitic life The houses without screens are in many cases mere huts or the crudest kind of habitations

The neglect of malaria in its early stages is universal There is in fact a great need for much better medical attention throughout Mexico to meet the ordinary needs of the poor population Treatment is usually by quinine which is often of an inferior quality Quinine prophylaxis on a large scale is unknown In my own case I took 10 grains of quinine a day during my stay in the tropics or sub tropics, and I did not suffer a single attack of malaria although I was often confronted with cases in a moribund condition The prevailing type of fever is not generally known on the basis of strictly scientific investigations But the prevailing impression is that the type is a mild tertian and more of an ailment than a disease taking a fatal cour e

Several physicians have expressed to me the opinion that malaria infections modify the prevailing types of venereal diseases in the direction of mildness and short duration

The thought has also occurred to me that the prevalence of malaria in the tropical lowlands might possibly be an inhibiting factor in cancer which is extremely rare among the native population

As yet as far as I can learn no efforts have been made in Mexico to apply malaria treatment in cases of general paralysis which however is not very common in the Mexican lowlands A letter from Dr Baker in the *British Medical Journal* of October 16 mentions a patient who had malaria of long standing but developed general paralysis in spite of it Very severe recurrences of malaria in no way hindered the progress of the cerebral condition to a fatal termination

Sanitary prophylaxis against malaria in Mexico is as yet only in its beginning Progress is very slow and often extremely difficult The population is poor and often ignorant as well as opposed to sanitary improvement Every state in Mexico has a fairly well equipped sanitary department and the same, of course is true of the larger cities The principles of public hygiene are fairly well understood everywhere, and by slow degrees a vast population of an indifferent type is being educated to its advantage

On the Isthmus of Tehuantepec malaria is not a very common affliction except in a narrow strip of the country along the coast In the City of Tehuantepec unfortunately, most of the death certificates are not filled in by a physician As far as I could learn there was only one medical practitioner in the town of 30 000 inhabitants and he was not held in very high repute

The larger cities of Mexico have good hospitals and in practically all of those visited I was shown cases of malaria in different stages of the disease The widespread occurrence of venereal diseases enormously complicates the situation The same is also true of hookworm disease Typhus fever, which was a scourge ten years ago is gradually diminishing and is no longer a serious consideration in the country as a whole

Water supplies nearly everywhere are of doubtful quality and in some instances positively dangerous to health and life On several occasions requests were made of me for the literature of our Public Health Service on malaria prophylaxis The difficulty, of course is that most of the physicians who could be most helpful are not familiar with the English language I feel strongly that the Pan American Sanitary Bureau should concern it elf more extensively with the malaria situation and cooperate more effectively with our National Malaria Committee

Summarizing these observations I feel that while the malaria problem in Mexico is probably next to venereal diseases the outstanding public health question the condition nevertheless has decidedly improved in recent years thanks to the active efforts of a well organized Federal Public Health Service The local situation while it is a serious one is not particularly alarming

I wish to refer briefly to the 'Results of Laboratory Work on Malaria in England by Dr S P James one of the foremost authorities on malaria in the world recently published by the Health Organization of the League of Nations and to quote from this report

In England the Government Department which administers the Acts relating to the care of mental patients takes the view that with regard to the malaria treatment of cases of general paralysis of the insane there are serious objections to the method of inducing the malarial attacks by the direct inoculation of blood from patient to patient The official arrangements in this

certain proportion of the cases should show a tertian type of fever or some one of the less mistakable marks of the disease. It goes without saying that many genuine cases of malaria fail to show anything very typical but a fair proportion of the histories ought to be more or less characteristic.

Confirmation of at least a proportion of the cases by blood examination for malaria parasites is indispensable.

History reports, then, are of value especially in delimiting some of the broad regional outlines of present or past malaria, but reports of this character should serve as guide posts rather than as final authority.

Mortality Records.—These need even more careful scrutiny than morbidity records, especially where the number of fatal cases reported is small and the danger of error consequently large. Certain insurance companies will not pay indemnities in case of death from syphilis or tuberculosis; in such cases a less scrupulous type of physician may substitute the more respectable for the more probable cause of death, or at least give the patient the benefit of the doubt, a benefit which does not accrue to the statistician.

The Spleen Index.—The proportion of children with enlarged spleens, an index of malaria long recognized as invaluable in the tropics, is of undoubted utility everywhere. Where the amount of spleen enlargement is small, however, the examiner should be on his guard in the interpretation of his results. We know that there are other causes of splenomegaly in children than malaria and we do not know just how long the spleen enlargement may persist after the acute condition of these diseases has subsided. The experience afforded by the examination of a large number of children in a region known to be malaria free is almost indispensable to the malariologist. Such experience will enable him to establish a standard and be in a position to estimate the significance of a spleen normally palpable or of enlargements due to causes other than malaria.

In all cases the examination should be a most careful and painstaking one designed to obtain the maximum amount of information from each case.

The Parasite Index.—The significance of the parasite index will of course vary with the character of the population examined. Where the amount of malaria in a community is presumably very small we have usually included in our surveys certain selected groups where the presence of malaria is most probable. Such groups are usually obtained through the co-operation of physicians and by house to house surveys and include persons with symptoms suggesting malaria or persons with a recent history of that character. As a corrective of the selected group we make use of the parasite index of children in actual attendance in schools, an index usually lower than that of children generally in a population since the seriously ailing children are likely to remain at home. Children more often than adults carry parasites in numbers sufficient for detection and negro children usually show higher parasite rates than the white.

Where the parasite rate is an important part of the research we believe it best for the investigator to examine a large proportion of the blood preparations himself, even if it becomes necessary to limit the time devoted to each slide. The investigator has a stake in the accuracy of the results such as a technician can but rarely possess.

The time required for the examination of blood preparation may be reduced by the use of the thick films. With such films carefully prepared and stained an experienced examiner can get over a great deal of ground in a few hours. The time and labor required for an extensive blood parasite survey is not so great as is ordinarily thought, especially for the worker who can alternate his microscopic work with other activities.

To mention a detail, we should especially emphasize the necessity of rejecting as negative preparations in which there is the least doubt as to the identity of the parasite. The examiner may pass over a real positive now and then by excess of caution but he will obtain a far more useful standard of comparison than if he commonly includes as positive anything at all doubtful.

The limitations of the parasite index are obvious: many carriers will have too few parasites to be detected by the most careful examination. The repetition of the examination of the same group will sometimes augment the number of positives obtained. MacDonald[1] examined daily for seven days those remaining negative among

1. MacDonald, G.: Malaria in the Children of Freetown, Sierra Leone. Ann. Trop. Med. and Parasit., 20:239-263, 1926.

desire to ask specifically what they are The one referred to was originated and developed by Americans as can be proved and one part of it can be checked at the United States Patent Office Washington D C

Also Dr Mayne's work of about 1915 1916 brought out the facts that only a very small percentage of potential American malaria conveying Anopheles (in malaria homes) become infective

Dr Victor Heiser I H B New York N Y—Just as a matter of record to offset the report of Dr Hoffman who stated that while in highly malarial regions during the year he took prophylactic quinine and did not contract the disease I may say that during the past year I spent much time in highly malarial districts and took no quinine and did not contract malaria

Dr James A Hayne Columbia S C—I stayed in a highly malarial district in Panama for two years and did not contract the disease As soon as I reached Monterey I had quite an attack which lasted for three months

Dr Hoffman (closing)—I unfortunately could not visit Tampico but I am familiar with the work of Mr LePrince and have read his reports As regards the mosquito question I am glad he has emphasized the essential facts although I am not so familiar with the local situation as I should like to be

With reference to prophylaxis I can speak only of my own experience For more than thirty years I have been traveling through the South and have never had either malaria or yellow fever I was in New Orleans during the last epidemic but did not contract the disease although I did not take any particular precautions In the light of my recent experiences particularly in South and Central America I firmly believe that quinine prophylaxis taking ten grains a day is an absolutely sure protection in most cases At least it has been wonderfully effective in my own case for I have been considerably exposed in highly infected localities

SOME METHODS OF ESTIMATING THE AMOUNT OF MALARIA IN REGIONS OF LOW ENDEMICITY*

By M A Barber[1]
W H W Komp[2]
and
T B Hayne[3]
Greenwood Miss

In a region where malaria is not only widespread but severe as in some portions of the *tropics* either the spleen or the parasite rate of a fairly large group of children may measure the malaria rate with enough accuracy for the purpose in hand Where the disease is comparatively mild, however, and malarial attacks of even infested persons are infrequent malariometry offers greater difficulties Such difficulties are found in some communities in the southern United States where indeed it is sometimes a problem to determine whether malaria in measurable amount is present or not

In our present discussion of the criteria of malaria surveys, we have in mind conditions under which the investigator must often work—limitation of time and means for an ideal survey

The History Rate—The value of history records in estimating malaria prevalence is unquestioned equally certain is the necessity of carefully scrutinizing such records before taking them at any large proportion of their face value Malaria is notorious for the number and variety of its symptoms Neither physician nor layman can be much blamed for an occasional mistake in diagnosis nor is it a wonder that malaria may be made a scapegoat for professional doubt An attractive scapegoat it is for all for to shift our simile to the invertebrata the blame lies more lightly on the mosquito than on some dietary or other unhygienic indiscretion of our own

Local physicians may disagree on the elemental question as to the presence or absence of malaria in their communities Official records based on the reports of these physicians then can hardly be trustworthy for purposes of estimating the malaria rate in smaller units of population for large areas the official reports may be more useful

The error inherent in the history rate is not a constant one In a community where malaria may be almost extinct the malaria tradition may remain strong Where the disease is getting a foothold or where cases migrate to a non malarious region its prevalence may be underestimated Smoke is an indication of fire but one cannot always judge of the extent of the conflagration by the volume of the smoke *Tradition may outlast a disease as smoke may outlast* a fire

The best course for the investigator is to collect all history material which promises to be of value then to use these data as a guide to further sources of information not as a final index of truth Sometimes a close scrutiny of the character of a group of histories will be of value Where there is really a good deal of malaria a

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results of the examination for splenomegaly among children should be interpreted with caution especially where a large proportion of the enlarged spleens is barely palpable. The history rate finds its greatest value as a guide to other sources of information. House to house surveys afford a most valuable index of the amount of malaria and are practically indispensable where the rate is very low. It is advisable that as large a proportion as possible of the data of a survey be obtained by the investigator in person. There is more danger of error through faulty examination by incompetent technicians than through the smallness of the sample.

DISCUSSION (Abstract)

Dr Mark F Boyd, Edenton, N. C.—I believe that the policy recommended of dividing the sample taken into one group chosen at random and another deliberately selected leaves great room for error, as the surveyor will have great difficulty in presenting and interpreting his results. It furthermore will complicate comparisons between two different places. I consider random sampling alone the best.

Blood and spleen examinations should never be considered separately. If we are going to utilize both methods of examination they should be done on the same people. You cannot compare the blood findings from one group with the spleen findings from another group.

Repeated examinations of the blood of the same individual while undoubtedly increasing the number of positives also introduces a factor that complicates an interpretation of the results. It is better to know that a single examination may [illegible] 10 per cent positives than that 15 per cent positives might be secured if some individuals were re-examined.

I feel that Dr Barber is unjustly pessimistic on the question of the reliability of technicians. Granting that incompetent or untrustworthy technicians exist, the individual employing a technician should satisfy himself that his technician is both competent and trustworthy. I can affirm that trustworthy individuals exist and that they may be satisfactorily trained. Certainly the time of any surveyor who insists on himself examining the smears he collects will be greatly limited as a result.

Mr Barber (closing)—A word in regard to the inclusion in malaria surveys of groups selected because of suspicious history or other evidence of malaria. Such groups are useful in preliminary surveys, especially when one is in doubt as to whether malaria exists in a community. In a complete survey we include unselected groups as well and record separately the results of each group. We commonly use children in schools as representative of unselected groups. Where both spleen and blood examinations are made we usually do both at the same time.

There are technicians whom one can trust and we have known of them. Generally however we believe there is less error when hundreds of examinations are done by the investigators themselves than when thousands are entrusted to technicians who have little or no scientific take in the results.

A HOUSE TO HOUSE SURVEY OF MALARIA IN THE MISSISSIPPI DELTA 1926*

By T. H. HAYNE,**
Greenwood, Miss.

A survey was made of malaria in the Mississippi Delta during the period beginning June 9 and ending August 10, 1926. The purpose of the survey was to obtain by direct inspection some information regarding the amount of malaria prevailing among the white and colored renter class on cotton plantations. House to house visits were made, persons ill with any diseases sought out, blood specimens were taken of such persons and every effort was made to determine whether the illness was malaria or not. A summary of the results of the survey follows.

Ninety five white families representing five hundred and seventy nine persons were visited. Sixteen persons, slightly under 3 per cent of the total, were found ill at the time of the visit. Not one of these sixteen showed malaria parasites in the blood. Forty eight persons were found who gave a more or less definite history of malaria of recent date. Blood examinations were made of these persons also and three carriers of malaria parasites found. About three fifths of the white people were examined in June, the rest in July and August.

Two hundred and five colored families representing 1 280 persons were visited. Forty six, or about 3.5 per cent, were found ill at the time of the visit. Of the forty six only one showed malaria parasites in the blood. In addition one hundred and forty one persons were found who gave a more or less definite history of recent malaria. Among these twelve carriers of malaria parasites were found. About one third of the colored families were visited in June, the rest in July and August.

Summarizing both races of the three hundred families representing 1 859 persons, only one sick person was found who showed malaria parasites in the blood. Fifteen parasite carriers among persons apparently well were found, that is about 5 per cent positive among three hundred and two examined, not a high percentage

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*Read before the National Malaria Committee (C[illegible] [illegible] Malaria) meeting jointly with Southern Medical Association, Twentieth Annual Meeting, At[illegible] [illegible], November [illegible] 18, 19[illegible]6.

**T[illegible] [illegible]ial Assistant, United States Public Health Service.

a group of children in Freetown, Sierra Leone This intensive method raised the parasite index from 48 to 85 per cent

During the current year we have examined a certain white rural school five different times three times during the spring term and twice during the autumn The number examined at any one time varied from forty to sixty nine Five different parasite carriers were found in the course of the five examinations The highest number found at any one examination was two Fifteen children were present at all examinations Only one positive was found among these fifteen that child was positive twice A negro rural school was examined three times Among eleven children present at all examinations four carriers were found at the first examination and one subsequently Several of the original positives were again positive on subsequent examinations In this region where the parasite rate is low the re examination of a school does not seem to have largely increased the proportion of positives detected

Whatever the limitations of the parasite index it affords a most valuable standard of comparison The examination of the blood discloses the degree of infestation of each carrier the type of parasite and not infrequently the amount and character of the anemia present On the whole the microscope probably gives more valuable information than any other single means of examination

Determination of the Sick Rate—By house to house surveys this affords information of the greatest value In our surveys we search for cases of illness from whatever cause take blood specimens and use every available means to determine what proportion of the people are suffering from malaria We have usually conducted such surveys during midsummer and have often continued them for weeks It would seem hardly possible that a great amount of malaria could exist in a neighborhood without some evidence of it appearing in these epidemiological cross sections, especially when this work is supplemented by the cooperation of the physicians practicing in the neighborhood

The Consumption of Quinine or of Other Fever Remedies—This has been accepted as a rough sort of criterion of the prevalence in a community of the disease for which these remedies are more often employed Such data must be judged in the light of the medical customs of the people We know of a community where the consumption of fever remedies increased materially with the immigration of people from regions reputed to be malarious But the fact that the sale of snuff increased *pari passu* with that of quinine suggests that we may be dealing with an example of the importation of habit not of disease

Malaria Among Bunk House Laborers—Occasionally an index of the amount of transmissible malaria in a community is afforded by the importation from relatively malaria free regions of gangs of temporary labor Such laborers, usually occupying bunk houses or other inadequate shelter are liable to epidemics of malaria and may give one a valuable although unwelcome indication of the number of malaria carriers among the indigenous population The malaria rate among groups of Mexican cotton pickers imported into the delta region of the Mississippi has given us some idea of the amount of malaria danger in different sections of Leflore County Mississippi

It must be remembered that the bulk of malaria in a region does not depend simply on the number of carriers of parasites but also on the frequency of malaria attacks among such carriers A method of measurement of malaria the parasite index for example may fail to give us the whole number of parasite carriers yet may afford a valuable index of the total amount of malaria suffered by the population In Central America we have found among the children of certain plantations parasite rates of 70 or 80 per cent Among children in the rice growing regions of southern Louisiana we found parasite indexes of 2 and 3 per cent It is probable that a larger proportion than 3 per cent of the Louisiana children were infected at some time during the year but the difference between 3 per cent and 80 per cent may roughly measure the difference in the actual amount of malaria sickness in the two regions In the tropics groups of children are found who show almost continual illness due to malaria a condition of things fortunately absent in Louisiana

SUMMARY

In estimating the amount of malaria in regions where the rate is low we recommend the use of all criteria practicable within the available limits of time and opportunity While no single index is satisfactory the blood parasite rate is probably the most valuable one provided it is based on both selected and non selected groups The

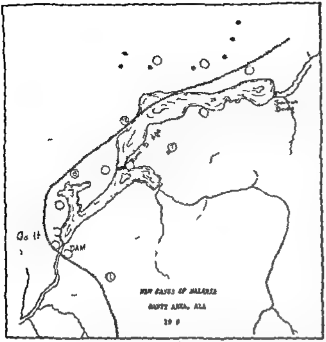


Chart I
M p of the Gantt Impoun led Ar a 1 Alab ma A dott d line is d awn within a o m le radiu f m the sho lin of the ro d In 19 6 all but three of the as of m la ia ccurring in the area we t home within the limits of this lin

Summary—Additional data are presented concerning the epidemic of malaria in the impounded area at Gantt Alabama *Anopheles quadrimaculatus* control measures were suc ce sful except for a short time and in a limited area The additional in formation coincides with that ob tained in the previous years studies and confirms those conclusions namely that *A quadrimaculatus* is essentially a pond breeder with a limited flight range of about one mile under usual conditions that *A quadrimaculatus* was the vector of malaria in the Gantt area and that when the breeding of this mosquito is checked the disease disappears

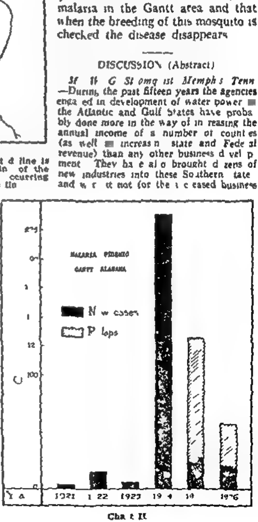
DISCUSSION (Abstract)

M H G St omq ist Memph s Tenn—During the past fifteen years the agencies enga ed in development of water power in the Atlantic and Gulf States have proba bly done more in the way of in reasing the annual income of a number of count es (as well as increas n state and Fede al revenue) than any other business d vel p ment They ha e al o brought d zens of new industries into these Southern tate and w r it not for the i c eased business

where *Anopheles quadrimaculatus* control was lost

The incidence of malaria during the entire epidemic is shown in Chart II During 1926 there were twenty one new infections and thirty six relapses The reduction in the number of relapses is striking when compared with 1925 and is probably due to intensive quininization of all carriers during the pring month

The incidence of malaria by months in the upper and lower areas of the pond is shown in Chart III Superimpo ed on the malaria graph i a graph howin the prevalence of the three species of anopheles It will be noted that in the lower area there was a relatively high in cidence of *A crucians* from May to September without a corresponding increase in malaria In the upper area however the increased prevalence of *A quadrimaculatus* was followed after a period of about one month by a definite in crease in malaria incidence This seems to offer additional proof that *A quadrimaculatus* was the important vector of malaria in the Gantt area and also that *A crucians* played little or no part in the distribution of the infection



Cha t II
Y ly i iden f mal ria f the Ga tt a ea f om 19 1 to 19 6 in lusi

considering the fact that those examined were a highly selected group

The survey did not disclose then, a large amount of malaria Even if half of the number ill had been suffering with malaria the malaria rate would not have been particularly high Two fifths of the people were seen in June, a month in which sickness is at a minimum, and about three-fifths in July and August months when malaria should be evident if it is at all abundant Up to September 1 the season was normal as regards rainfall and mosquito production

Of the sixteen positives found nine were estivo autumnal five benign tertian and two quartan

A survey of certain economic factors was made at the same time as the malaria survey The results are summarized in Table 1

TABLE 1

SUMMARY OF FACTORS INCLUDED IN ECONOMIC SURVEY OF DELTA PLANTATIONS

Number of families visited		30
Condition of Houses—		
Good	65	
Medium	15	
Poor	18	
Unclassified	4—	0
Houses with some screening	169	
Houses with bad nets	97	
Houses with no mosquito protection	69	
Houses examined for Anopheles	129	
Number of Anopheles found	— 357	
Water Supply—		
Artesian	103	
Wells with pumps	1 3	
Open wells	7	
Pipe	1	
Not classified	13—	30
Families having kitchen garden	86 out of	9
Families keeping cows	3 out of	83
Families keeping poultry	43 out of	291
Families keeping hogs	7 out of	93
Families having automobiles	117 out of	77

Noteworthy is the fact that about 56 per cent of houses had some kind of screening But little over one third use artesian water a point worth noting by those who ascribe the bulk of the decrease in malaria to the use of artesian water Judging by the percentage which have gardens cows or poultry it would seem that these families do not wholly lack variety in food The large percentage of automobiles per family does not necessarily indicate a highly mobile population since many of the automobiles were incapable of locomotion

FURTHER STUDIES OF THE IMPOUNDED AREA AT GANTT, ALABAMA*†

By W G SMILLIE M D
International Health Board,
New York, N Y

The malaria studies of the impounded area at Gantt, Alabama for the period 1923 1925 have been reported in detail[1] This paper is a brief report of the continuation of those studies during the malaria season of 1926

It is not necessary to review the previous report nor give a history of the Gantt epidemic of malaria and methods used in its control

During 1926 the methods of study followed were the same as those described in the original report The area was impounded throughout the malaria season Clearing had been effected in accordance with state regulations though in some of the small inlets and bays in the upper area near Simmons Bridge (see map) the clearing was not perfect Supplementary control measures were used consisting of oil spray under pressure from a motor boat This work was carried out by the company owning the reservoir and results were checked by the county health officer or his assistants

Regular searches for anopheles larvae were made by the inspector and when they were found the spot was indicated by a white flag The spray boat then redoubled its efforts in areas where complete control had not been gained *Anopheles quadrimaculatus* were well controlled in the entire lower half of the pond during the entire season but control was not complete in one area of the upper half of the pond from June 15 to about July 19 Following the increase of *A quadrimaculatus* prevalence in this area there occurred an increase in cases of malaria the cases being limited in great part to the area of *A quadrimaculatus* prevalence

This is well shown in map (Chart I) It will be noted from this map that only three cases occurred near the dam four near Dunn s Bridge and the remainder on the north side of the pond

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*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta Georgia November 15 18 1926

†From the Field Training Station International Health Board and Andalusia Ala

1 Smillie W G Studies of an Epidemic of Malaria at the Gantt Impounded Area Covington County Alabama Am J Hyg Baltimore 7 40 7 Ja [illegible]

regulations for more than two years before they were promulgated When promulgated they represented im proved standards of control suggested to the State Board of Health by the best authorities in the country Wherever any of those a ked to advise us objected to any procedure or anything was criticized it was cut out The regulations as they stand represent approved methods of control unanimously advised by the best sanitarians in the country

When the power companies first backed water up without a permit and we demanded that they dewater the area they refu ed We d d not give in one inch and at about the time the trial was to come up they said they were w ll g to obey the regulations that we were right and they were wron and if we would with draw the su t they would do anything we asked Th elim nated opposition on the part of people who wanted to impound small areas of water We have had no more trouble I s mply wish to say to those health officers who have the problem on the r hands stand pat do not g in one inch

Mr J A LePrince USPHS Memphis Tenn—It is to be hoped that the rep esentat es of the International Health Board will keep on digging deeper into th impounded water problem and determ ne some of the important factors that none of us has yet reached which may compel us to change our method of control of anopheles development in impounded water projects and incidentally d velop a more rapid and more eco nomical proced re than we have u ed in the past

You will notice th t the owners of the lake site at tempted to s destep the problem of clearing the lake basin and did not remo e the cut down brush and trees It finally cost them about tw ce hat it would ha e done to complete the clearing before impounding the water The unit cleari cost n p ojects com pleted d ri g the pa t fe y ar has increased to a serious e tent and unque t onably there is a lar e field for vestigation along that line and also n d s ng n w and better method of ontrol nvolv n no new risk that w ll make it poss ble to om t many of the p esent cle r n operat s For in tance the floatage might be so treated that in tead of increasing anopheles product on it wo ld serve as an egg collect agency for the la t quad maculatus bro d that should exist in the v cinity of the lake We compelled stegomyia crops to destroy themselves twenty years ago and it is not impo ible to make the quadrimaculatus lay the r eggs where the l ae cannot survive

I was very glad to note how closely the flight range of quadr macul tus at Gantt s Lake corresponds with that determined by previous ve t gators ten years ago n th northern and souther sections of South Carolina It ould be of inte t to determ ne to what ex tent the few quadr maculatus at i olated houses beyond fl ght ra ge of the lake or g ate in containers and also to dete mine the e act character of other plac s n nature that they ome from This brings up anothe qu stion If in the river vall y wher water i to be impounded the *Anopheles q drimaculat s* a e relatively scarce before the water is impounded in it and sources of quadrimaculatus a e relati ly fe v it would proba bly not be an e pens e or d fficult matter to trap the eggs and trap the adults for a period of two years be fore the pond was mad and then determi e what would happen

I should very much like to believe that this spec es radiates out n all di ection each ni ht from its source In inve tigational work with other anopheles this was not found to hold true Apparently further investi a tion i needed to prove that they do or that they do not always do so

Dr Smillie s data seem to indicate that where the anopheles are most numerous there is most malaria which makes us wish to think that a large number of anopheles is necessary to produce an epidem c This may be true in an impounded water project and the ep demic may fail to develop near other places where the same species of anopheles is even more numerous Is there something about the new impounded water project or newly opened up country that involves un investigated factors? Perhaps under certa n conditions the infected anopheles have a longer avera e life or perhaps a larger percenta e of them become infective The main difference between a pond or lake less than three years old and long e tablished lakes is the amount of floatage on the water surface What do we know about the influence (d rect or ind ect) of this floata e n relation to the power of anopheles to transmit ma laria? I am glad that Dr Smill e and h s co workers selected for study a narrow lo lake that is somewhat similar in character (in anopheles production) to the upper quarter of the long narrow inlets of some larger proje ts A very important point yet to be investi gated is the poss bility of devisin an entirely new rapid and economical method of prevent anopheles production in narrow and l ng (or wind shaded) inlets of lakes where plenty of floata e or other protect on for anopheles larvae exists I do not yet believe we have said the last word n fish control methods no that the control method for impounded water projects which we now use will be standard w thin the next five years Better and less expensive methods f control necessary For the succes ful and mo e rapid d vel m nt of the Southern states we must reduce the first co t of power development

Dr M A Fort Ba nbridge Ga—Spring Creek s the boundary line between Decatur County Georgia on the east and Seminole County on the west It p oba bly averages 60 feet wi le and six feet deep with con s derable current There is an outcropping of lime stone at various places alon the valley and there are limestone sp ings The valley varie from a few hun dred ya ds to a mile in width and is covered with a swamp of gums pines cyp ess and many other tree and underbrush Normally there is very little water in the swamp Out on the hills border ng the valley are a numbe of farms of very good land

In 1920 a power company of local capitalists con struct d a dam across this creek backin the w ter up nearly to Brinson eight m les above and mak ng a lake of so much of the valley There was cons derable f ct on with the natives who claimed that mo qu toes and malaria were increased This contention c t ued unt l 1925 n January when the dam w as d stroyed by a freshet

In March 1925 I was asked by the company if there was anything they should do to prevent mos quito b edi while the dam was dov n I visited the site and we t a considerable d stance up the st eam d pping in what hol s I found There were a few quadrimaculatus larvae in some holes which soon dr ed up Inqu ry at the homes proved that there were no mosquitoes of any k nd along the valley during the whole summer I su ge ted to the comp ny that as lon as there was no dam there ould be noth n to

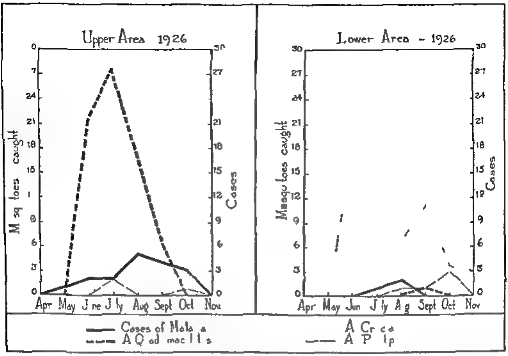

Chart III
Relation hip b tween th in lence of malaria and the in idence of A uad imaculatus in the uppe half of the Gantt Impounded A ea in 19

activity that they have created large numbers of fam ilies and merchants in the states in which they operate might not be so well off as they are at the present time

Not only have these agencies created local state and Federal wealth but they also have in most instances voluntarily expended hundreds of thousands of dollars in takin precautions that the man made chan es of topography connected with their projects should not create any potential unhealthful conditions

In fact in some in tances their activity has been systematically investigated by our constituted health authorities who determined that some projects resulted in decrea n the local malaria prevalence

This bein the case it m of interest to sanitarians and others to determine to what extent the agencies that are bringin prosperity to sparsely settled rural districts and nearby towns are receiving county and state cooperation and support from constituted health authorities and from such organizations as ours Un questionably the program and objective of the Na tional Malaria Committee as originally stated in print was intended to offer suggestive or other cooperation

Here we have a condition where business executives are carrying on health work are carrying on malaria control operations on a much larger financial scale than all other anti malaria activity in our country taken as a whole Those who are doing the best sanitary work are being attacked and robbed for doing applied sanitation

They have in a number of instances undertaken a much more thorough malaria control campai n than the requirements of the state board of health called for Yet they are frequently subject to legal attacks and are embarrassed and sometimes lose their le al cases be cause the state departments of health have insufficient data as to malaria prevalence and insufficient funds and machinery to gather data in the localities where the county and state revenue producing project has been created

The state health officials of each of the states of the South with potential water power sites are all inter ested in malaria elimination and are also interested in having sufficient tate and county revenue to enable proper functioning of tate and county health depart ments with adequate trained personnel So why cannot some action be taken to protect the agencies which are producing a con iderable portion of the present income and wh ah will produce more in the near future as more impounded water projects are developed?

It would appear essential for proper and normal state development that a majority of the bu iness interests of the state the tate health official and the ma lariologists get t ether on this problem with a view to having full time health units installed in all counties in the near future where ater power will be later devel oped so that the past and present status of malaria prevalence w ll be approximately known in all counties where future impounding of water will take place

This is a health problem upon wh ch a part of the future status of county and state health department funds depend and it should receive the attention from the National Malaria Committee that it merits

Dr S W Welch Montgomery Ala—This has been one of the mo t interest ng developments the State Board of Health has ever had It relates very clearly the power wh ch an organization has over the financial world provided its regulations are reasonable As Dr Smillie says these people began their work before we had formulated our regulations We worked on the

Dr F M Boldridge Charlotte N C—I should like to ask Mr LePrince one question What can be done that is not at present being done by two or three of the large power companies of the South to prevent malarial mosquitoes?

Mr J A LePrince U S P H S Memphis Tenn—They should (1) take necessary action so that three years (or not less than two years) before the preliminary topographical surveys are made the state health authorities shall determine county malaria prevalence and take a malaria census each year thereafter in a zone three miles wide parallel to the flow line until two to three years after the water is impounded Such work is essential to proper state development and prosperity of counties that have water power sites

(1a) There is no known reason why the power development agencies of nine Southern states cannot get together in a unit for the sole purpose of seeing that this is done and that it is done effectively They should keep a committee to see that this activity is not allowed to die down

(2) The water power development agencies must obtain through a competent malariologist the past malaria history of every man they place on the water shed of the project from the time work is started until work is completed and after that of the retained permanent force Also a malaria blood test of each man must be made at once by a reliable malariologist after the history is given In addition a similar malaria history of any sawmill gangs on the water shed should be obtained A copy of each such record should be sent to the file of the general manager of the company In the past this matter has been ignored or done superficially with resultant lawsuits following Because of this neglect there are potential lawsuits yet to appear in the near future that are anticipated by sanitarians but probably *not by the chief engineer and chief surgeon* or executives of the companies involved.

(3) All buildings in which construction labor or employes sleep on or near the water shed should be kept effectively screened and arrangements made so that it will not be possible for the screen to be non effective for a longer period than twenty four hours Also all employes known or suspected to be carriers of malaria should take suitable quinin treatment and swallow the pills in the presence of the medical officer or his representative

(4) It would be highly advantageous to have an inspection made by trained malaria field workers of the state board of health in the month of August at each farm home two years and one year respectively before the lake is *formed to determine*

(a) *Anopheles quadrimaculatus* prevalence at each home

(b) Reported malaria case determination and confirmation

(c) Location of *A opheles quadrimaculatus* breeding near homes

(d) Items (a) and (b) to be repeated in August of the first and second summer after the water is impounded and public records of these four items to be kept on file at the state board of health and copies furnished to the power company

(5) The agencies interested in the development of water power should form an organization to study anti malaria activity methods and results obtained and actively *encourage the expediting of new anopheles control* measures applicable to impounded waters that will reduce first costs and operation costs of malaria elimination at or near impounded water projects

(6) Full time county health units should be established so far as possible in advance in all counties that have potential water power sites It is never too early to establish such units

(7) On a large (and potentially malarious) project where most of these precautions were taken there was less malaria after the project was completed than before it started Also there were no lawsuits

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ENGINEERING IN MALARIA CONTROL*

By J A LEPRINCE,**
Memphis Tenn

Your Sub Committee on Engineering has undertaken the investigation of malaria control in areas where large agricultural drainage projects have been installed We submit the following as a preliminary report

You will appreciate the fact that it may take several years to collect satisfactory and conclusive data relative to desirable maintenance methods for anopheles control in various parts of major drainage schemes as there are variations of soil that will probably make it essential to have several methods of control available to suit local conditions encountered and to control the collections of floatage and accumulating growths *such as semi aquatic plants that furnish protection* for anopheles larvae from their enemies

In the investigations carried on to date we find there are a number of localities that have been agriculturally drained where the result has been a reduction of anopheles but where it is found that sufficient anopheles are being produced in the water in the drainage ditches or laterals in July August and September to be of sanitary importance In such territory malaria yet appears to be the major health problem of the county health unit although unfortunately it has not been found that the county health officers are seriously concentrating on or attacking their important malaria problem They are not even using emergency methods In some of these large farming areas we find the production of anopheles confined almost exclusively to the drains of the drainage districts and it is probably safe to state that the malaria sick rate will drop very rapidly as soon as a practical and

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**Special Sanitary Engineer U S Public Health Service

control but there would probably be a different condi tion when the dam was rebuilt

About October 1925 a farmer living near the dam came to me saying that the mosquitoes were terrific Upon investigation I found that the dam had been re paired the water was slowly rising and the homes were infested with large numbers of quadrimaculati Hollow trees in the swamp were lined with the mos quitoes and their larvae were discovered not only near the ed es but all over the pond as well There was much floatage of sticks chips bark straw refuse from burnt over woods as well as algae and other floating growth making ideal conditions for quadrimaculatus breeding

At once I took this matter up with the power com pany urging them to get ready for control before spring The company changed hands several times and after each change I renewed my efforts to have them in stitute control measures but no control was attempted

By early summer of 1926 the production of quad rimaculatus was enormous Garages and stables would show not hundreds but thousands Homes both screened and un creened showed hundreds in pite of the daily use of prays and smudges

An interesting evidence of how far quadrimaculatus travel in numbers sufficient to be a menace was shown by a survey Every house east west north and south of the pond within 1 5 miles was heavily supplied with mosquitoes But at two mil s or over none were found or at most only one or two As this same con dition obtained on every side of the pond it eems clear that where the production of mosquitoes is large protection must extend to homes for two miles from the breeding place in south Georgia

At some time during this year (1926) probably 90 per cent of the people had malaria and 90 per cent of the children examined had palpable pleens Probably four hundred and fifty people were affected That re sults were no worse was due principally to the fact that we furnished them with quinine at cost and persuaded them to take it constantly instead of chill tonics

To my mind there was never a clearer demonstration of the transmission of malaria the dan er of uncon trolled impounded water the agency of the quadri maculatus than this Yet a few phy icians in the county do not believe that the pond increased malaria Quadrimaculatus mosquitoes palpable spleens and acute malaria practically disappeared both up and down the creek as soon as a di tance of two miles was traveled

Late in the summer of 1926 certain citizens living near the pond entered suit for dama es against the com pany Before the date for the trial a meet ng of the attorneys and health officials was arranged and the power company agreed to employ an expert build a boat equip it with tank and compression apparatus and cut lanes through the swamp and brush so that they could pray the entire area at regular intervals They agreed also to empty the pond the following sum mer and clear the entire pond basin leaving only the border to control Work to this end has begun It will be difficult to get perfect control until the pond cleared of all timber and obstructions and one boat is probably not enough for the work

The dam is leaking badly and the water is steadily falling There is a general opinion that if the dam breaks again or if other plants of this company are connected the company will dismantle this plant and thus settle the matter

Dr James A Hayne Columbia S C—I saw in the paper two weeks ago that Georgia and South Carolina would have a large project in McCormack County This will take in a large portion of Georgia and a small portion of South Carolina

Dr T H D Griffitts USPHS Biloxi Miss—For several years I have investigated the influence of newly impounded waters on malaria incidence Last year I was in charge of sanitation for a power company which was preparing the area for what was said to be the largest artificial lake in the world covering 40 000 acres and having an irregular shoreline of 500 miles The draw down is 60 feet In other words the variation in the water level will be 60 feet The regulations of the State Board of Health in the State provide amon other things that all brush trees and undergrowth which would pierce the surface of the water at low water level shall be cut off at least one foot below the low water level to prevent the collection and anchorage of floatage In this enormous area logs and brush were felled and the logs wired down by the u e of eight gage wire anchored to stumps to prevent their floating This measure does not in itself necessarily reduce to any great extent the amount of fine floatage which will arise from the area below the minimum water level In preparing an area of this kind it is ad isable after felling the trees and brush to burn everything that will burn in order to get rid of material that will later constitute fine floatage for floatage makes the home for *Anopheles quadrimac ulatus* By selecting a dry time and burning the area the cost and time of tying down will be greatly re duced and from 50 to 75 per cent or more of floata e material will be eliminated Workmen can then get through the brush more easily and find the logs that require anchoring

One other phase of malaria control on impounded waters is very important Undoubtedly the land de *partments of some of the large companies* have been able to do much more effective work in malaria pre vention than have their med al and urgical depart ments I mean by this that the purchasing or leasing of lands in a zone extending from a mil or more out ward from the maximum contour and removing the population is much more effective in some cases than state regulation I have in mind one example that of the lake above Mitchell Dam on the Coosa Ri in Alabama There following fairly good preparation of the basin and work on the lake after the impoundage there was still quadrimaculatus production in numbers great enough to have caused an epidem c of malaria had *it not been for the fact that the land department* of the company purchased sufficient land almost to depopulate the region within a mile of the lake

The preliminary preparation of the basin is only a means to an end for generally peakin anti anopheline work will have to be continued for the first two or three years on most new ponds in order to guarantee control sufficient to prevent malar a

I will also mention the importance of blood examina tion made by a competent technician in the case of all laborers brought into an area for work in the basin or on the project works

In the impound d water area discussed in Dr Smillie s paper no one who was famil ar with the lack of prep aration of the basin was surprised at the outbreak of malaria With quininization the first year and a pond profu ely stocked with gambu a it was not headed off

"The anopheles is a little stronger flyer than the stegomyia Its habits are those of the country mosquitoes for the reasons I mentioned Of course it breeds some everywhere but these are general terms Its flight is more than of the stegomyia though perhaps the farthest we put it down at is two hundred yards I mean for practical sanitary work in protecting a house or town we should give directions to take the measures cleaning the trash and draining and looking after the receptacles and so on for two hundred yards around the house

This case evidently provoked much discussion among malaria men for the United States Public Health Service assigned Dr Carter Mr Le Prince and Dr Griffitts to the study of this body of water

That much was found out we all know today The control of impounded waters has passed from the realm of investigational findings and theories through established facts into the realm of concrete achievements

There are three large basins in Alabama which have been put up practically within the year Two were raised during the summer or at the worst possible time from the health angle Little malaria has resulted One of these basins covers 40 000 acres and its waters lap the shores of three counties The population living within flight range (one and one half miles) of these basins runs into the thousands Each basin was prepared under our regulations and our control measures were used after the water was up

Had these three reservoirs been built ten years ago a different picture would have been presented

Not only has our knowledge increased but special control apparatus has been developed from time to time as the situation on each basin demanded Men of intelligence have been placed in charge and control organizations formed These have been guided by the State Board of Health The cost has run from 30 cents to one dollar per acre pond area The companies have found this cheaper in dollars and cents than defending damage suits As the years pass some basins need less and less control work and the cost is enormously reduced The regulations have been strictly enforced even through appealing to the courts when necessary One sixteen hundred acre basin was dewatered and properly prepared as were two others which were smaller

The purpose and intent of this work is to prevent the building or increase of malaria foci All the while old foci are being found and eliminated wherever possible

A summary of the projects under permit is given herewith

Number of impounded water areas	50
Number of counties in which areas are located	24
Number of areas before 1923	4
Number of areas in 1923	8
Number of areas in 1924	8
Number of areas in 1925	21
Number of areas in 1926 (to date)	[illegible]
Total number of acres in area	73 7 8

List of impounded areas before 1923 (not put up under permit)

Mitchell Dam	19 1
Gantt	19 1
Newton Dam	19 2
Lock 12	1914

Mitchell Dam (5 500 acres) was voluntarily prepared according to directions and no trouble resulted It is interesting to note that violent epidemics occurred around the other three Gantt Newton and Lock 12

The total number of areas before 1923 in acres was 29 860 Lock 18 (now under construction) will be 5 000 acres The grand total is 118 588 acres

The various counties report the following work done during 1926 to date

SUMMARY OF MALARIA WORK AS REPORTED BY COUNTIES (ORGANIZED)

Known Epidemic Foci in Counties

(a) Beginning of season	60
(b) Increased during season	2
(c) Decreased during season	6
Total at present	56
Number of these foci in which needed larvae control has been made	47

During Season

(a) Number of foci eliminated	11
(b) Number of foci partially controlled	[illegible]
(c) Number of old foci maintained	2
(d) Population protected	119 300
Cost of control (labor and material)	$12 3 24

Ditching

New ditching 1 980 yards cost $3 985 00
Old ditching cleaned and maintained 18 400 yards
oiling of [illegible] 30 000 gallons total cost about $15 000 00

Local Mosquito Control Measures were Carried on in

(1) Birmingham	(5) Mobile	(10) Piedmont
(2) Cloverdale Chisholm	(6) Demopolis	(11) Anniston
(3) Selma	( ) Ray Minett	(1) Dothan
(4) Opelika	(8) Foley	
	(9) Fairhope	

Counties Not Yet Reported

Colbert	Mobile
Covington	Montgomery
Lauderdale	Talladega
Limestone	Tuscaloosa

MALARIA CONTROL 1926 AND PROPOSED FOR 1927 IN GEORGIA*

By T F ABERCROMBIE M.D **
Atlanta Ga

During the year 1926 our Division of Sanitary Engineering rendered service to about thirty mu

*Report of National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta, Georgia November 15 18 1926

**Commissioner of Health of Georgia

economic method of mosquito control for the ditches is devised

The two important sub problems to be solved are

(1) The elimination or cheap control of formation of small deltas (or silting of channel) that occurs where laterals or roadside ditches enter the larger ditches and

(2) The reduction or elimination of plants grasses and trees in the section of the ditch that stays wet in the anopheles season

The small deltas referred to often keep water in ditches that would otherwise remain sufficiently dry during the anopheles season to prevent anopheles production In fact without these delta like obstructions the ditches might act as anopheles egg traps and frequently as destroyers of young anopheles larvae Upstream from the small deltas we find ditch water impounded for a distance of from a hundred yards to a quarter mile or more and sufficient vegetation in this shallow water to protect the larvae We have also found that willow trees growing in the ditch beds are the cause of serious silting and collection of debris and floatage

In studying the silting problem in connection with growth of vegetation in ditch beds in general it has been noted that in several instances where there was sufficient tree shade properly located there was no vegetation in the water or on the banks that the water flow line was free of obstructions and free of satisfactory resting places for anopheles larvae while immediately upstream and downstream from the properly shaded ditch it was very easy to collect numbers of anopheles larvae

Investigations carried on during the past ten years in the Carolinas show a similar absence of anopheles larvae where the ditches or stream beds are shaded by wild honeysuckle and a similar profuse production of larvae of anopheles directly upstream and downstream from the area of sufficiently shaded water surface Of course from time to time larvae can be washed into such places but not many remain and reach the pupal stage We had our investigations extended to the Texas Mexican border and it was found that anopheles production in the borrow pits adjacent to the irrigation water supply ditches can be markedly reduced by proper shading We found nature at work there doing such work unaided by sanitarians and indicating to us the new anopheles control procedure we are now investigating and developing

We have been advised that there is no information available as to what extent shade trees affect the growth of aquatic vegetation in irrigation canals or in the borrow pits adjacent thereto

Our plan is to devise a means of preventing anopheles production in borrow pits adjacent to irrigation ditches in territory where malaria is now on the increase and to devise a satisfactory means of control of anopheles propagation in the agricultural drainage districts of the Mississippi Valley

We realize that in certain classes of soils it is possible to reduce anopheles production in relatively flat bottomed ditches by means of a second or smaller ditch within the ditch bed but such work will not always reduce the silting problem because of the rank growths that will develop along the dry bed of the old ditch In the silt soils that flow when water soaked we cannot use this procedure and must use others If our investigations show that it is feasible and economical to prevent anopheles production in borrow pits and enormously to reduce anopheles in agricultural drainage project laterals by means of proper shading then the best, quickest and cheapest method of bringing this about will be our next problem and it will have to be performed in such a manner as in no way to interfere with the operation of ditch cleaning devices or ditch maintenance machinery

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MALARIA CONTROL WORK IN ALABAMA*

By S W WELCH M D **
Montgomery Ala

In 1912 the Alabama Power Company built a dam at Lock 12 on the Coosa River It backed water up fifteen or twenty miles into the uncut vegetation and timber

In 1914 the number of malaria cases as reported had increased from approximately twenty five to six hundred The people affected sought legal redress through damage suits and as usual expert witnesses were called in Among these was General W C Gorgas Through the many pages of his testimony given in February 1915 the danger zone was stated and emphasized as 200 yards for the anopheles flight range The following excerpt is taken from his testimony

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*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta Georgia November 15 18 1926

**State Health Officer

MALARIA CONTROL IN LOUISIANA*

By OSCAR DOWLING, M.D.,**
New Orleans, La.

Since 1918 this Board has advised and assisted communities in mosquito control. During the past biennial period in addition to giving advice and engineering assistance, a start has been made on a program for malaria control on a parish wide basis. In the parishes of Caddo, Natchitoches, St. Mary and Tangipahoa surveys have been made to determine amount and distribution of malaria, and the directors and sanitary inspectors of the health units in these parishes have been given training in field work. Programs for the work have been prepared and furnished the directors of the health units, and in Natchitoches and Caddo Parishes particularly the directors have been assisted in promoting community campaigns, in organizing parish officials and citizens for cooperative effort and in introducing the study of malaria into the schools. The following table summarizes some of the details of the work for 1925.

Communities aided in malaria mosquito control	18
Surveys and cost estimates for control programs	8
Communities visited	23

The malaria death rate continues to show an annual decrease, the rate for 1924 being 15.1 and for 1925, 13.4 per 100,000 population. In 1918 the rate was 28.7.

The State Board of Health has cooperated with official agencies of the States of Alabama, Mississippi and Louisiana in the request for governmental assistance in the investigation of the salt water mosquito. An appropriation for this work was included in the Agriculture Appropriation Bill. A study is being conducted at the present time of this problem.

MALARIA CONTROL ACTIVITIES IN NORTH CAROLINA*

By H. A. TAYLOR, M.D.,†
Raleigh, N. C.

Beginning in 1922 the malaria control program of the North Carolina State Board of Health was made a part of and to apply primarily to counties having full time county health organizations.

A Division of Malaria Control is maintained through the cooperation of the International Health Board as a part of the central organization. The division has for its primary objective the rendering of aid, giving advice and to encourage county health organizations in the development of a malaria control program which may be considered applicable to the county in question.

A study of the malaria problem in North Carolina reveals the fact that owing to the wide distribution of the disease in the eastern section and the opportunities offered for transmission no definite control program can be offered to the county authorities until a detailed study of the problem has been made as to prevalence and factors responsible for its spread.

There are at present thirty six full time cooperative county health organizations within the State and thirteen of these are situated in the eastern section, or what is known as the malaria belt of the State. Each organization has a rate sufficiently high to make the disease of sanitary importance.

The malaria belt of the State may be said to comprise a total of thirty three counties situated along the eastern coast. It is within these counties that the harmful effects of the disease is felt, and where the State is concentrating its efforts toward control through the organization of full time county units with adequate personnel to handle the situation as the prevalence of the disease and its economic importance in each county may demand.

It is believed that the successful handling of any malaria control program is entirely dependent upon adequate and well trained personnel. In this connection county health officers well grounded in the fundamental principles of malaria control are essential in the development and execution of any plan or program of whatever magnitude may be presented.

That malarial control, or reduction on a county wide basis, is well within the realm of possibility of the average county health department has been strikingly demonstrated in North Carolina. In two counties, after three years of intensive work by the local county health personnel there has been a reduction in active malaria of approximately 60 per cent, bringing the rate from what is believed to be the highest for any county situated in the malaria belt to rates comparable with those counties where the dis-

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†Di[illegible] to B[illegible] f M[illegible] Co[illegible] [illegible] St[illegible]te B[illegible]rd [illegible] H[illegible]lth.

nicipalities on mosquito and malaria problems, chiefly in sections where anopheles are a menace. County health officers were rendered assistance on malaria problems. Dippings for larvae were taken throughout the state and the anophelene larvae identified. The identifications were spotted on a state geological map together with the mortality distribution which map designates the distribution of our malaria problem. Malaria and mosquito literature was distributed as an educational measure. Assistance was rendered in promoting drainage districts. Hydroelectric companies were required to clear areas before impounding water and subsequent control measures were effected. A number of proposed hydro electric companies are now preparing to comply with regulations regarding impounding of waters. The program for 1927 will be the same as for 1926.

MALARIA CONTROL OPERATIONS IN MISSISSIPPI*

By Felix J. Underwood, M.D.,**
Jackson, Miss.

The organization of the Mississippi State Board of Health embraces a Division of Malaria Control through which advisory and supervisory aid are rendered throughout the State on malaria and mosquito control programs.

The plan in instituting malaria control work is essentially to make a study of the problem within any given county, the county having been adopted as the unit of area, to determine the foci of infection and the factors contributing thereto, and to decide what suitable inexpensive method may be employed to control the disease in the various sections of the county.

In one Mississippi County, beginning in 1921, such a plan was instituted, the results obtained being most satisfactory after six years of continuous operation, the annual per capita cost to the county being six cents, a figure suitable for consideration by any full time county health department.

By following the plan which is outlined in reports of the Mississippi State Board of Health any county within the state having an adequate full time health department and a population of 30,000 or more can satisfactorily reduce malarial fever to the control point within a reasonable length of time, about five years, for an annual budgetary cost not exceeding ten cents per capita, regardless of the extent of the problem if the work is made part of the general program and continued without interruption throughout the years.

During the past eleven years malaria morbidity in Mississippi has been reduced 52 per cent and mortality 73 per cent.

For the first nine months of the present year there has been only a slight reduction (1.13 per cent) of cases reported as compared to a like period for the preceding year.

Despite the increase in control activities during the year, the expected reduction in cases of malarial fever did not occur, and in general mosquitoes of all of our common species except *Aedes sollicitans* were more numerous than for several years past.

During the first quarter of the year, total blood examinations recorded showed positive findings equal to a like period in 1924, and 100 per cent more than in 1925. For the second quarter the rate of positive findings were about equal for 1925 and 1920, and 32 per cent less than in 1924. In the third quarter, with more malaria reported than for a like period during the past six years, blood findings showed 22 per cent less positives than in 1925 and 39 per cent less than in 1924.

Approximately equal numbers of blood smears were examined during the periods except for the first quarter of 1925 when approximately 70 per cent more smears were examined than during the same periods of 1924 and 1926.

For the year 1927 it is planned to continue through the Division of Malaria Control, the rendering of advisory aid throughout the State, special attention being given to those counties in which there are full time health units and a malaria problem of sanitary importance. Educational work, and the encouraging of industrial and developmental bodies to realize the economic importance of controlling malarial fever and lend support to its control, will also be continued.

There is not in the State of Mississippi any problem in malaria control that cannot be effectively dealt with by following a reasonable program.

The tendency of the desire of the people in this State is toward general mosquito control and to be able to follow up such a lead would hasten the control of malarial and dengue fevers.

*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twentieth Annual Meeting, Atlanta, Georgia, November 15-18, 1926.

**State Health Officer.

PROGRESS IN MALARIA CONTROL IN OKLAHOMA*

By CARL PUCKETT M D **
Oklahoma City Okla

The Department of Public Health as a part of its malaria control program made a survey of malaria in Oklahoma during the months of April May and June this year This work was ably done by Dr Henry P Carr of the International Health Board assisted by the different bureaus of the Department

A review of Dr Carr s findings and recommendations will best explain the malaria problem for Oklahoma

Malaria is limited by topography rainfall and altitude to the southeastern section of Oklahoma This area includes about twenty counties (Oklahoma having seventy seven counties) Red River which has a broad flat valley forms the southern boundary of the State It is in this section that malaria is most prevalent In the east central section of the State the Arkansas River with its tributaries presents a somewhat similar condition to that of Red River

The southeastern section of Oklahoma is for the most part wooded and mountainous the country becoming prairie westward along the Red River and northwest toward central part of the State The population is distributed along the fertile valleys of the streams The rainfall in this section is more than 40 inches per annum The distribution of malaria is in great part limited to the southeastern quadrant of the State

Dr Carr relied upon the presence of an enlarged spleen as a method to determine the incidence of the disease Children from two to twelve years of age were examined in their homes In addition to the examination of the spleen histories and blood films were taken

The table at the top of next page gives the incidence of malaria in Oklahoma in the counties investigated as determined by splenic index

The incidence and severity of malaria in Oklahoma has been on a decline for the past ten or fifteen years This can be in part explained by the fact that the land has been cleansed of timber and more drainage projects have been put into effect with the increasing agricultural development

It would, however be unfortunate to allow the fact of this natural decline in the disease incidence to obscure the importance of the very considerable magnitude of the malaria problem which exists at the present time in southern and eastern Oklahoma

The development of the oil industry probably plays a minor part in the decline of the case rate

The Future Possibilities of Impounded Water in Oklahoma—The development of water power in Oklahoma has not been carried out to any extent However it is a question of only a short time until the water power resources of eastern Oklahoma will receive attention In the future the malaria control problem will be largely concerned with the proper impounding so as to eliminate as far as possible the production of breeding places of the anophelene mosquitoes Dr Carr s investigations around the lake in McAlester Pittsburg county demonstrated the importance of this phase of the problem He examined twenty one individuals who had lived within the area through at least one malarial season Of these 52 3 per cent had enlarged spleens and 44 1 per cent gave histories of chills and fever within the previous year In the construction of this lake very little clearing of the basin was done before the water was impounded At present there is under consideration the impounding of a much larger lake in the malarial region of the State The Department of Health through its sanitary engineers is planning to take necessary steps to prevent the formation of malarial hazards such as that of Lake McAlester The problem of impounding water will necessitate the securing of legislation covering this phase of the problem precedent for which exists in the regulations already in force in other Southern States

Organization of County Health Units—Probably the most important step taken in the control of malaria in Oklahoma has been the organization of local full time county health units in three of the largest counties of the area concerned In these counties adequate programs are already under way which promise the solution of the malaria problem This program consists essentially of the determination by the health officer of the relative magnitude of the local health problem due to malaria The health officer then prepares from all data available including spleen examinations of the school children at the time of the regular school examination a malaria spot map of the county showing location of all cases of the disease Where the individual problem is well defined

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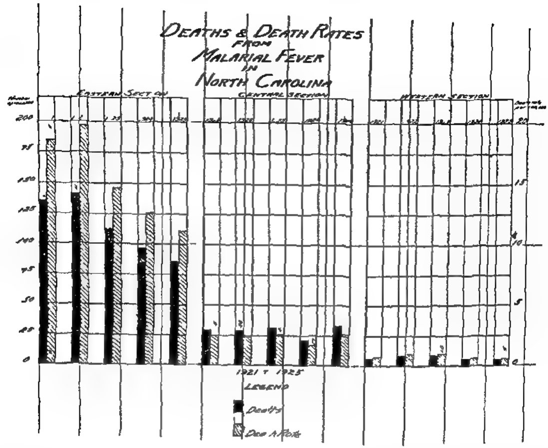
*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta Georgia November 15 18 1926

**State Health Commissioner



ease is not of serious public health importance The cost has been surprisingly low and as the personnel with the control program as well as the operations of the plan have been absorbed into the general program of the county health departments it is expected that the work will be continued

The Division has also been engaged during the present year in studying what if any influence the impounding of water for hydroelectric purposes may have on the incidence of the disease Malaria and mosquito surveys are being conducted over areas where impounding is contemplated to determine normal mosquito production and the normal rate of infection It is expected that similar studies will be conducted after the areas have been flooded The preliminary data so far collected has been most encouraging and it is believed that by extending the studies through 1927 much additional and valuable information will be gained which may be used as a basis in formulating rules and regulations for mosquito breeding as pertains to the impounding of water

CONTEMPLATED MALARIA PROGRAM FOR 1927

(1) Extension of the malaria control program on a county wide basis to two additional counties situated within the malaria belt of the State

(2) Render aid and advice to county health organizations which may be helpful in determining the status of the malaria problem and the contributing factors thereto in each county

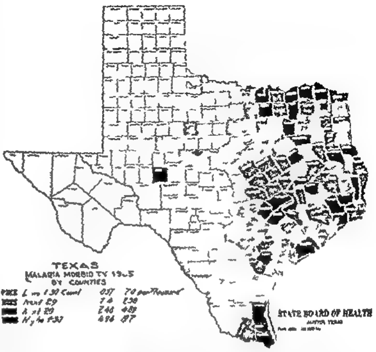
(3) Field station studies of especially selected counties or areas will be continued as a means of further training the personnel of the various county health departments in the fundamental principles of malaria control

(4) Surveys of urban areas will be made and estimates of costs will be submitted for the control of mosquito breeding upon request by the governing officials

(5) Locating of impounded waters in the State and study of the incidence of malaria and mosquito prevalence in relation thereto

with occasional visits by representatives of the State Board of Health In 1925 26 86 town had full or part time in pection while 52 had intermittent local inspection as complaints were registered and had occasional visits by a representative of the State

Approximately $55 000 was spent by towns having a regular budget item for malaria control this amount was probably equalled by towns making no fixed expenditures but having adequate provision for the work. The Engineering Department expended the $5 000 annually appropriated by the Legislature for malaria control The entire expenditure in the State for the biennial period was roughly $120 000



The towns listed for mosquito control work are situated in 104 counties approximately 95 000 square miles in area and represent a population of over four million something like 80 to 90 per cent of the entire population The work was confined to incorporated towns and cities so that only a part of the population was directly affected

Mosquito control of some sort is performed in connection with almost all organized efforts in public health work in the State Malaria control work pure and simple is confined almost entirely to the malaria sections which lie principally in the eastern southern and central parts of the State (See accompanying map for location of heaviest malaria incidence)

Mosquito control with particular reference to the *aedes* was carried on for years on the border under the supervision of the U S P H S This work was abandoned in June 1926 as the mosquito index had receded so as to be of small importance Local communities and county health units in this section are continuing this work covering an area of some twenty to thirty thousand square mile and embracing a population of about a hundred thousand The State Board of Health provides necessary supervision over this work as well

One hundred ninety two deaths were reported from malaria in 1925—a small ri e over the previous years Approximately 70 per cent of deaths are at present reported in Texas and 11 502 cases of malaria were reported by a woefully incomplete number of physicians It would probably be no exaggeration to say that the average yearly number of malaria cases in Texas was 50 000 or over

In each town where the services of the State Board of Health have been extended it has been the policy to inform the people as to the various methods for control emphasizing the protection to be gained from properly screened houses Destruction of breeding places around houses including harboring places is likewise instituted It has been shown that a weed cutting campaign is useful in that it uncovers multitudes of old tin cans bottles and other receptacles which afford breeding places for culex Campaigns against pest mosquitoes are conducted in conjunction with malaria control campaigns for the usual obvious reasons

In those towns not having the advantage of good natural drainage it has been found economical to spend money on digging ditches for permanent drainage The city of Tyler found the use of dynamite an economical investment in ditch-digging Some towns have been fortunate in getting cheap or free crank-case drainage from garages and have found it cheapest to oil local streams and ponds while still others who are

INCIDENCE OF MALARIA IN OKLAHOMA COUNTIES

County	Type of Terrain	No of Exams	No Pos	Per Cent Pos
McCurtain	Valley	309	63	2 0
Pushmataha		29	65	22 0
Choctaw		209	41	14 1
Bryan		225	47	20 8
Pittsburg		64	14	21 8
Pittsburg	Near Impounded Reservoir No 3	21	11	52 3
Latimer		49	16	32 6
LeFlore		113	[illegible]	34 5
Muskogee		77	16	20 8
Muskogee	Prairie	67	2	2 9
Canadian		?1	3	4 3
Total examinations in valley section		1 362	317	23 2
Total examinations in prairie section		135	5	3 6

the cases of malaria and the breeding places of *Anopheles quadrimaculatus* found a summary of the observations is made and presented to the State Bureau of Epidemiology This bureau will then suggest the most practical and inexpensive method of control

In addition to this specific program there is another important activity that we have included in the work of malarial control namely general education of the public in regard to the whole subject of malaria prevention, and instruction in the common simple, well proven methods of anopheles control

MALARIA CONTROL ACTIVITIES IN TENNESSEE*

By E L Bishop M D **
Nashville Tenn

The basic element of the malaria control program for the Tennessee State Health Department [illegible] the establishment of full time health organizations as rapidly as possible in all counties with a malaria problem Up to the present six county health departments have been established in West Tennessee which is the only section of the State having a malaria problem Four of these county health departments—Obion Dyer Lauderdale and Shelby—fall in the tier of six counties which border the Mississippi River An attempt [illegible] being made to develop malaria control operations as a major activity in these four counties and in the counties of Weakley and Gibson The general plan of attack [illegible] by educational work and anti mosquito measures An attempt [illegible] also being made to secure placement of the standard treatment for sale in both drug stores and cross road stores

The Division of Sanitary Engineering has made surveys of malaria breeding places on [illegible] county wide basis in Weakley county and of certain areas in Lauderdale and Shelby counties Consultant service is being rendered by this Division to all full time health departments in West Tennessee Town surveys have been made of Clarksville Dresden Martin Greenfield Covington Dyersburg and Gallatin

During 1925 Tennessee experienced its first malaria epidemic due to impounded waters This was at Cookeville where the city had installed a municipal hydro electric plant damming up Falling Water River for some three miles Control measures were instituted immediately as follows The reservoir was cleared of floating and standing timber and the edges of grass and brush Oiling and prophylaxis were used

Surveys were made this year (1926) early in the spring at Falling Water River dam for maintenance and a survey for results was accomplished about the middle of September The results of the latter survey are as follows

P ons in survey	93
Malaria cases in [illegible]	37
Malaria cases in 19 [illegible]	15
Net reducti n in a	2
R d cti n in mala i evide tly due to malaria control wo [illegible] at the re voir	59 4%

OUTLINE OF MALARIA CONTROL WORK IN TEXAS*

By H O Sappington M [illegible] **
Austin Tex

In 1924 25 101 towns in Texas were listed as carrying on malaria control measures 76 employed full time inspectors and 25 part time

Rep rt to Natio al Malaria Committe (Confe nce on Malaria) meeting c njointly with Southern M dical A ciation Twent th Annual Meeting Atlanta Geo gia Nov mb r 15 [illegible] 19 6

Commi i ner of H alth of Tennessee

R port to the National Malaria Committee (Conferenc on Mala ia) meeting conjointly with the South rn Medi al As ociation Twenti th Annual M et ing Atl nta Georgia, November 15 [illegible] 19 6

State [illegible] alth Officer

The following towns obtained only partial control because of indifference or only spasmodic efforts being put forth

Alto	Frost	Mineola
Alvarado	Groesbeck	Mineral Wells
Athens	Jefferson	Navasota
Atlanta	Killeen	Palacios
Brookshire	K e	Palestine
Caldwell	L abank	San Felipe
Calvert	M lin	Rockdale
Canton	Ma t	Temple
Carthage	Midlothian	Trinidad
Franklin	Milford	Weatherford

MALARIA CONTROL ACTIVITIES IN VIRGINIA*

By H G Grant M D **
Richmond Va

The program for the year 1926 carried out by the organized counties of Virginia in which malaria is a problem was as follows

(A) (1) Locate all ponds (natural and artificial) and write pond description Sample A will give you an idea

(2) Dip all located ponds once a month for larvae Identify and make record on charts as sample B

(3) Collect adult anopheles once a month and record on chart as sample C Charts furnished by the Malaria Bureau

(4) A free hand sketch to be made of every pond including one mile of surrounding territory Scale not necessary Sample D

(B) Home history index of 1925 and 1926 and spleen index of malaria for 1926 at end of season around all ponds within flight range Record on map as per instructions Office record to include name of occupant house number number of occupants and malaria cases

(C) Investigation of every case of malaria reported during year by physicians and from other sources.

(D) Securing actual control by screening oiling Paris green and draining when possible Control of pond by clearing of floatage and varying water level

(E) Supervision of maintenance of urban malaria control and securing new work where necessary

(F) Educational work through schools lectures literature posters newspaper publicity and exhibits

To complete this program it was necessary for the county health officer in all counties to devote one full day of his time per week from the beginning of May until the end of November In two counties Nansemond and the Isle of Wight malaria is a major problem and it has been necessary for the health officers to devote two and sometimes three days a week to fulfill this program

In all our counties the ponds have been located sketched and dipped at regular intervals Adult anopheles have also been trapped identified and recorded The home history index has been taken and is complete for the areas surrounding the ponds with the exception of our two counties Nansemond and Isle of Wight where it is only possible with the amount of time allocated to do a certain amount of this work Spleen indices will be completed during the latter part of November and the first two weeks in December

The amount of control effected has not been very great The idea in this program was to locate exactly our malaria foci so that in 1927 we could intensify on control

Control by the towns was featured during the beginning of our malaria work in Virginia This work is still being maintained and is in good shape

In the unorganized counties the only work done has been educational with the exception of surveys which were made in the counties of King George Mecklenburg and Middlesex

Control Work Supervised During 1926—The major control in Virginia has been carried out at Lake Prince under the supervision of the county health officer of Nansemond County Lake Prince is a water supply for the city of Norfolk The city has already cleaned the lower part of the lake and during October began to clean the bights which extend into Isle of Wight County These bights have been created by flooding the wooded area and as a consequence there are many trees standing in the water For the purpose of cleaning a special scow has been constructed In the front of the scow there is a large circular saw which can be lowered by a lever The scow is brought up and the saw lowered so that the tree is cut well below the water level the tree is then hooked on to a hawser and from there run on to the shore Fluctuation has also been carried out in this lake with complete success in the cleared portions The following figures show clearly the amount of control effected

	1924 Pct	1925 Pct	1926 Pct
Home History Index	53.9	44.3	14.05

Lake Cohoon in the county of Nansemond is also a heavy breeder It is the reserve water supply for the city of Portsmouth Negotiations are under way to have this lake cleaned

*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twentieth Annual Meeting Atlanta Georgia November 15-18 1926

**Director of Malaria Control State Board of Health

supplied with cheap labor clear their waters of weeds and debris and stock them with fish as a control measure

TABLE OF MALARIA MORBIDITY IN TEXAS BY COUNTIES FOR YEAR OF 19 5

County	No of ca es	Population (est 19 5)	Rates (per 1000)
Ande on	16	35 400	0 45
Angel na	50	7 000	1 85
Au tin	78	18 100	4 31
Ba t op	155	8 500	5 44
Bee	[illegible]	1 200	4 03
Bell	50	54 000	0 9
Bexar	11	182 000	0 0605
Bo que	11	17 400	9 9
Bowi	177	4 900	4 23
Bra o a	28	16 900	1 66
Brazos	72	2? 400	3 21
Burl on	1 2	1 200	5 75
Bu net		9 870	0 0
Caldwell	3	9 00	0 788
Calhoun		4 200	0 4 7
Cam ron	334	45 700	8 40
Cassa	0	3 500	1 54
Chambers	67	3 400	19 7
Ch ok e	129	40 500	3 18
Clay	9	15 900	0 566
Coleman	2	400	0 134
Collin	196	56 400	3 48
Colorad	4	0 100	1 19
C mal	4	8 950	0 447
Comanche	1	2? 400	0 045
Cooke	161	4800	6 09
Coryell	4	5 900	0 9 6
Dallas	127	215 000	0 59
D lta	51	16 950	3 01
Dent n	28	36 000	7 84
DeWitt	97	33 500	90
Ellis	128	60 800	2 11
Falls	105	4 700	2 46
Fannin	699	48 00	14 14
Fayette	164	30 400	5 40
Fo t Bend	53	24 000	2 21
Franklin	10	9 650	1 04
Free tone	178	6 400	6 75
Galvest n		49 300	0 446
Goliad	65	11 700	5 5
Gon al s	36	33 900	1 06
G ay on	281	77 500	3 63
[illegible]	118	[illegible]	6 80
G mes	1 7	26 000	4 89
Guadalup	31	3 000	0 97
Hamilton	2	14 400	0 129
Hardin	208	17 400	11 95
Harr s	478	183 000	2 61
Ha rison	1	56 000	0 21
Hays	1	17 100	1 3
Hend r on	196	3 600	6 01
Hidalgo	145	48 [illegible]	2 99
Hill	9	48 600	1 1
Hopk ns	91	37 900	2 40
Hou ton	[illegible]	25 000	2 61
Hunt	[illegible]	65 100	5 19
I ion	13	1 530	8 50
J ck on	1 7	0 00	7 79
J ffe on	87	81 500	3 5
J hn on	19	7 600	0 506
Jone	4	27 000	0 89
Karn s	44	4 400	1 80
K ufman	93	44 800	6 45
Lama	343	56 400	6 10
LaSalle	4	8 800	0 455
La aca	11	400	0 434
Lee	106	15 900	6 6
L on	11	19 9 0	0 551
L be ty	161	17 400	9 5
Lim tone	18	44 800	4 17
Madi on	111	1 900	8 60
Ma ion	10	14 050	7 33
Matag rda	1 6	13 800	12 75
Ma e ck		7 000	0 86
McL nnan	58	8 000	97
M lam	1 8	41 700	3 07
Mitchell	1	11 900	0 034
M ntague	3	1 050	1 80
Montgomery	4	19 300	2 18
Mo ris	33	11 4 0	88
Nacogdoches	0	33 900	5 96
Na a ro	35	66 600	0 5 5
Newt n	9	10 600	2 74
Nueces	1	29 000	0 414
Orange	38	16 000	38
Palo Pinto	13	0 100	0 65
Panola	5	5 00	2 14
Parker	5	21 800	0 3
Polk	[illegible]	19 650	3 87
Red River	64	37 300	7 08
Robertson	11	30 800	3 64
Rockwall	4	9 00	4 89
Runnels	6	1 00	0 293
Ru k	1 9	3 700	3 95
Sabine	40	13 400	98
San Patr cio	11	15 700	0 70
Shelby	163	33 000	4 94
Smith	9	54 900	0 71
Tarrant	58	134 000	1 9 5
Titu	97	18 00	5 33
Travis	76	[illegible] 100	1 18
Trinity	71	15 550	4 6
Tyle	[illegible]	11 00	0 714
Up hu	110	[illegible] 500	4 31
Van Zandt	29	33 800	1 1 4
Victoria	19	18 100	1 05
Walker	94	18 100	5 0
Waller	7	11 500	0 609
Wa hington	1 0	28 500	5 97
Webb		38 500	0 18
Wichita	2	[illegible] 000	0 037
Willacy	[illegible]	4 700	1 56
Wilba ger	7	17 800	0 393
William on	03	45 600	4 4
Wilson	38	1 800	1 6
Wis	17	22 300	0 76
Wood	64	5 700	2 3
118	11 210	3 951 6 0	2 837

Rate fo p pulation of reporting counties [illegible] p r thou and

Rate fo total e timated population of Texas (5 040 000) 2 2 4 pe th usand

Th e timat d p pulation was arrived at by adding one half the growth between 1910 19 5 to 19 0 figu e The e timat d population of countie was obtain d by the p portionate chool en llment (19 4) of ach county based n a total of 5 040 000 population and 1 3 1 01 chool nrollme t

The malaria figu s we e obtained fr m monthly re po t f as een nt in by Tex phy icians The b ol te figu s a th fo p b bly much too l w Even f r comparative pu po s they a partly tiated ty th impe f ct r po ting ome countie in th ma la a b lt r po ti g no a es whatev r Howev r the f gu s do g ve a ough idea of th d st ibution of ma la ia in Texas

Du i g 19 6 th f llowing towns btai ed good con t ol of mo qu toes and m st of them m intain full t me anitary inspect g fo Howeve th prob lem do not pe i t th year und in all of th e town hen the n pect r is mploy d trictly for mo quito ont ol ork du ing th mo t a p ci us ason fo m quito s n mely from M y to Octobe No mbe

Austin	Godthwait	Mt Pleasant
Beaumont	Go man	Nac gd ches
B llville	G env lle	New Brau f l
Blooming G ove	H nd s n	Normange
Bonham	Hi	Pari
B nham	Hillsb	P l nd
B yan	Hon y Grov	Rob t wn
Cam on	H t n	S n Ant ni
C nter	Hunts ill	San Augusti e
Cl	Hubba d	San Ma c s
Cl burn	Italy	S n B nba
Col man	Jacks nvill	S m rville
C llege Stati n	Kerr ille	Ro kwall
Commer e	Lanca t	R sk
Cool dg	Laredo	T ylo
Dallas	Living ton	Teagu
De [illegible]	Lone Oak	Terrell
Eagl Pas	C vet	T mp n
F tl nd	He ne	T ity
Edg w od	Lo gvi w	Tyl
Elmina	L fkin	Wa o
En l	Malon	Waxaha hi
Farm vill	Mar h ll	W t
F t Wo th	M Kinn y	Will Point
Fou ney	M ld an	W th m
Ga l nd	Mesqu t	
G t sville	M xia	

SYMPOSIUM ON MALARIA

Papers and Reports Presented at the Conference of the National Malaria Committee, Meeting Conjointly with the Southern Medical Association, at Memphis, Tennessee, November 14 17, 1927

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Symposium on Malaria

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CONSTRUCTIVE PROGRAM FOR MALARIA CONTROL*

By Wm E Deeks M D,†
New York N Y

In order to complete their life cycle malaria parasites require two hosts certain species of anopheles mosquitoes and man Sexual conjugation takes place in the stomach of the mosquito followed by the development of oocysts and sporozoites Asexual reproduction takes places in man with the development of gametocytes, male and female Malaria parasites produce pathological lesions or disease in both hosts which may prove fatal to either one

In man the febrile reaction and the symptomatology are due mainly to (1) the toxins liberated during the sporulation of the parasites and (2) the blocking of capillaries by the parasite infected corpuscles

The gametocytes apparently produce no lesions nor symptoms and are innocuous unless withdrawn by the mosquitoes in the stomachs of which their biological functions are consummated Otherwise in the human host they eventually die and are phagocyted like any other dead body cells

In order to make any progress in malaria control the problem must therefore be attacked from two angles (1) *mosquito destruction and* (2) the elimination of parasites from the human subject and the most important of these from the epidemiological standpoint are the gametocytes

Before discussing constructive measures for malaria control in either of these directions the introduction of some recently developed data is in order

In both hosts the individual s resistance or tolerance to malaria infection varies greatly In mosquitoes this depends in part at least upon environmental influences and nutritional conditions *In man in addition race and heredity* are important factors

It is questionable if we should use the term immunity in connection with malaria infection By the term active immunity we recognize a more or less permanent condition that develops in the body as a result of the invasion of a pathogenic organism or some modification of it or its toxin which prevents a re invasion or re infection by the same organism This condition however may be present as a result of individual heredity or it may be even racial in character In the case of malaria we know that many individuals have a high tolerance to the infection, and others after repeated attacks or relapses develop gradually a high tolerance to it so as to become relatively immune Generally speaking however one attack of malaria does not confer immunity from a second attack in the sense that we use the word when we speak of immunity to measles scarlet fever or yellow fever

Individual men and individual mosquitoes can be *classified either as poor moderate or good* transmitters of malaria infection Some individual men have such a high tolerance to the disease that it is almost impossible to infect them either by the intravenous injection of infected blood or by infected mosquitoes even though repeated attempts be made Others again become infected but develop such a small number of gametocytes that they are practically non infectious to mosquitoes or infectious only to a slight degree On the other hand a large percentage of men are readily subject to infec*tion and develop large numbers of gametocytes* in their blood and consequently can readily infect the susceptible mosquitoes that feed upon them

The same conditions precisely have been found to exist in individual mosquitoes Some particularly those living under good nutritional conditions and in a good environment apparently resist infection others become infected and may develop oocysts some of which abort and do not produce porozoites while a third group are readily infected produce large num*bers of oocysts and large numbers of sporo*zoites over prolonged periods One of Colonel James mosquitoes continued infective for *92* days when it died and during this period dis

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*R ad b fore National Malaria Committee (Conf e ce on Malaria) m ting conj i tly with South rn Medical A sociation Tw nty First Annual M eting Memphis Te n e Nov mbe 16 17 1927

†General Man g Medical Department, Unit d Fruit Company

ther observations confirm this result plasmochin will have proven to be of great epidemiological importance At present we are unable to state definitely the exact ultimate results of plasmochin treatment on the gametocytes but it is our impression that in most cases they are eliminated completely as far as clinical observations over prolonged periods and thick film blood examinations can determine and that in others the results are only temporary and sooner or later parasites reappear in the peripheral blood It is necessary that further observations be made before a definite conclusion can be reached

We are inclined to believe that malaria relapses are due to insufficient quinin treatment or to a lowered resistance on the part of the patient as a result of malnutrition or other coincident depressing influences such as infections or organic degenerations that interfere with the patient s ability to overcome the infection Sporulation continues in the deep viscera in such a mild form that the schizonts can be cared for by the defensive agents of the body which however are unable completely to overcome them There is a guerilla warfare or struggle for existence on the part of both but no decisive battle When the resistance of the defensive agents is lowered the sporulation activities increase to the extent of giving rise to symptoms and relapses occur

That gametocytes do not transmit or cannot transmit malaria without passing through the intermediate host is indicated by an experiment of Dr Ian Mackenzie[8] who reports the case of a Syrian admitted to the hospital with amebic dysentery

> His blood was found to be swarming with crescents, and in spite of prolonged examination of more than 100 films no ring forms could be discovered There had been no clinical evidence of malaria for many months Blood from this subject was injected directly into the basilic veins of five members of his family who lent themselves for the experiment in quantities of 1 2 4 8 and 8 c c respectively In no case did these injections produce an attack of malaria. Some time later 0 5 c c of blood containing plasmodia from a case of subtertian malaria was injected into this Syrian Within ten days he was readmitted with a typical paroxysm his blood was swarming with ring forms In this condition 0 5 c c of his blood was injected into the members of his family previously inoculated with crescents Four out of five developed an acute attack within two weeks

Confirmation of this experiment would go far to settle one of the long mooted questions concerning malarial relapses

In plasmochin apparently we have the last link in the chain of measures necessary to the effective control of malaria and the results obtained rest on the intelligent application of our knowledge An effective control program embraces first mosquito control and second the cure of the human carrier In regard to mosquito control there are some points to consider that are of the greatest practical importance

In the plantations of the United Fruit Company it has been found that almost 75 per cent of the foci of anopheline mosquito breeding are in the immediate vicinity of our habitations under conditions which are largely man made in character They however, are easily corrected with intelligent supervision and economical expenditures

Dr Julio Alessandrini[9] of Rome states in effect that agricultural development meaning proper land drainage clear running water abundant algae and sunlight (all of which favor the ideal development of anopheles) creates a type of mosquito which is more resistant to malarial infection

> Anophelism without malaria is a biological state of resistance temporary or permanent acquired by the anopheles and due to better conditions of life and with that better vital functions This state protects the anopheles from malarial infection
>
> Malaria in its extension and severity is in inverse relation to the organic resistance acquired by the anopheles during its larval state resistance which is due to the biological influence of the medium in which it has lived

The practical conclusions to be drawn from these observations can readily be appreciated when we realize that domestic animals are usually kept about our habitations and produce muddy tracks and wallows favorable to the breeding of mosquitoes with poor resistance and hence more susceptible to malaria infection than those whose larvae are developed under better living conditions

Mosquito control must be practiced either against the larval or adult stage and this is more readily done in the former In undrainable areas we have found that Barber s Paris green method is the most efficacious and economical for larval destruction although under some special conditions petroleum in some forms may be more satisfactory In unscreened quarters adult mosquitoes can be satisfactorily dealt with daily swatting as recommended by Le Prince or better still by insecticide sprays Without question the proper screening of houses is the most effective method of protecting people from the bites of mosquitoes providing the house dwellers take advantage of this method

charged sporozoites into human subjects on more than forty occasions This observation demonstrates the importance of the destruction of mosquitoes in habitations, as was recommended many years ago by J A LePrince in Panama [10]

The number of gametocytes found in the peripheral blood in human malarial carriers, varies in different individuals and in the same individuals at different times The thick film blood examinations of the inhabitants of an infected community in an untreated area shows according to the survey of Dr H C Clark [2] that gametocytes are present in from 8 to 15 per cent of those carrying malarial parasites in their peripheral blood, and S P James[1] states that they vary in number from 1 to 700 per cubic millimeter of blood Darling believed that at least 12 to the cubic millimeter are necessary in order to infect mosquitoes and there appears to be no question that those individuals carrying large numbers of gametocytes are much more infectious to mosquitoes than those carrying small numbers and are in consequence chiefly responsible for the spread of malaria

Colonel James believes that owing to the many hazards incidental to the life of mosquitoes not more than 5 per cent of potential mosquito infectors ever become active infectors A dissection of the anopheline mosquitoes caught in the labor barracks of the United Fruit Company during any one day according to Doctors Barber and Clark,[5] shows that only from 1 5 to 5 per cent carry oocysts

In the thick film blood survey of 7 201 individuals in the United Fruit Company plantations, made by Dr H C Clark[5] in 1926, 29 8 per cent were found to be infected and of this percentage 13 5 per cent carried gametocytes These were representative groups of the inhabitants taken from the port towns intermediate settlements and as far out as the most remote camp in certain valleys At the same time Dr Clark examined the blood of 124 malaria infected individuals on their discharge from the hospital after they had received 30 to 45 grains of quinin daily for a variable period which averaged 7 days Before they were discharged all the acute symptoms had disappeared the patients felt well, and were able to work Of these 43 5 per cent revealed gametocytes as against 13 5 per cent of those examined before treatment was given In addition to those carrying gametocytes 17 cases showed a few young forms and 3 cases showed only young forms and no gametocytes Dr Clark has an accurate record of only 10 of those carrying ring forms The 3 cases which contained ring forms only, were treated 2 3 and 4 days respectively Seven of those which contained rings and crescents were treated 7 days or less

Dr Clark has recently surveyed in a similar manner, and over the same areas, the bloods of 4,974 individuals of whom 27 1 per cent were found to be infected This survey was confined to the camps that had in his first survey shown the highest rate of hospital admissions due to malaria Previous to this second survey quinin had been given interruptedly through the preceding months to a large number of those examined and it is interesting to record that the gametocyte percentage was 31 3 against 13 5 per cent in the first survey, previous to which no quinin had been *given*

These findings suggest that the administration of quinin favors the development, or in any case the appearance of gametocytes in the peripheral blood a conclusion which has been confirmed by Doctors Connor Macphail Cordes and Brosius of the United Fruit Company Staff, on cases that have been kept in the hospital on quinin treatment 30 to 45 grains daily for periods ranging up to 12 days and in one of the cases up to 56 days Generally speaking the gametocyte rate in acute cases on admission to the hospital approximates from 8 to 15 per cent After quinin administration this increases within a week to approximate 40 to 50 per cent

We know that quinin is a curative agent in acute malaria, in that it assists in ridding the peripheral blood of the asexual forms of the parasites which alone are responsible for the symptomatology Until Dr Clark s recent observations confirmed by others it was not generally known that the estivo autumnal gametocytes are not destroyed by the exhibition of quinin but, on the other hand quinin favors their appearance in the peripheral blood and cases so treated carry more gametocytes proportionately than non treated cases Darling and others many years ago drew attention to these findings but their importance in the control of malaria has never been sufficiently stressed in view of the fact that Darling Ross, Wenyon Barber and others have shown that crescents developed under such conditions are just as infectious to mosquitoes as those developed when no quinin is given

Herein lies the value of plasmochin, as it apparently influences directly the destruction of the gametocytes or in any case drives them from the peripheral blood and thus renders the human host non infectious to mosquitoes If fur

nation 2 both estivo autumnal were positive and finally on the twenty ninth day, or the fourth repeated examination all were negative

The importance of good living conditions and proper nutrition in the treatment of chronic malaria cannot be too highly stressed The food must not only be adequate in quantity but of a character which furnishes the proper amount of protein fats carbohydrates and inorganic salts balanced as to the alkaline and acid character of the ash and also containing the necessary vitamin values

We recommend that chronic cases should be kept under observation and tonic treatment instituted after the blood becomes parasite free until the physical condition of the patient is normal The tonic treatment used by the United Fruit Company is a combination of quinin iron arsenic and nux vomica The amount of quinin in each tablet is 2 grains and 4 to 6 tablets are administered daily

To make the above program of malaria control effective we must have intelligent cooperation and this can only be brought about by teaching our people the essential factors of malaria infection transmission prevention and cure Undoubtedly this can be most effectively done in our elementary schools and should constitute a compulsory part of the educational program In this way within a few years the whole population in malaria infected districts would be sufficiently enlightened on the major problems of malaria control to know how to take care of themselves and as self preservation is one of the first laws of nature the outcome could not help but result in efficient malaria control

SUMMARY

(1) Malaria is a disease which affects man and certain anopheline mosquitoes

(2) Individual susceptibility to infection is a variable factor

(3) A constructive program for malaria control must be directed toward mosquito destruction and the cure of the human carrier

(4) Short radius sanitation about habitations with larval destruction is indicated also

(5) Adult mosquito destruction in habitations by insecticide sprays

(6) Quinin is mainly effective against the asexual forms but favors the development or appearance of the estivo autumnal gametocytes in the peripheral blood

(7) Plasmochin is mainly effective against gametocytes in the peripheral blood thus rendering the human carrier non infectious to mosquitoes Plasmochin however produces toxic symptoms in some individuals which circumscribes its usefulness

(8) Good living conditions and a properly balanced adequate diet are important allies in the cure of malaria

(9) Education of the inhabitants of malaria infected communities in control measures is strongly recommended and essential to effective malaria control

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Discus ion f llow pape of Dr B ber page 11

TREATMENT OF MALARIA WITH PLASMOCHIN*

By WILLIAM KRAUSS M D †
Memphis Tenn

Heretofore our only means of controlling malaria carriers consisted in preventing the production of gametes by giving quinin continuously until the mature gametes had died out This is a slow process requires too long a time for detention in a ho pital and the after treatment by

Read bef re N ti al Mala i C mmitt (Co f c o Mala l i meeting c j intly wi h So th rn Medic l A oci ti Tw ty First An al Meeti g M mphis Te e see No mb 14 17 19 7

†Professor f Tropical M di i e Uni rsity of T n nessee C ll g of M di i Memphi T nness

of protection during the mosquito flight which must include the hours from sunset to sunrise

Treatment of Malaria Infected Individuals Two phases of the parasite must be considered in the treatment the asexual forms and the gametocytes The activities of the former are responsible for the symptoms in the infected individuals the latter for the transmission to mosquitoes For the asexual forms in almost all cases we have an efficient remedy in the salts of quinin For the gametocytes an equally efficient agent is plasmochin which is also of undoubted influence in clearing the peripheral blood of the asexual forms of the benign types of malaria It is our belief that these agents (quinin and plasmochin) are not directly toxic to the parasites but act only in conjunction with the natural defensive agents of the body The exact nature of these agents, whether cellular humoral or both is unknown In most cases it may be stated that effective doses of quinin 30 to 45 grains daily will free the peripheral blood of asexual parasites and also all acute symptoms within 8 days but in some cases when coincident infections or debilitating organic diseases are present much longer treatment is indicated and we must be guided as to the necessity of further treatment by the result of repeated blood examinations for the presence of parasites The physical condition of the patient must also be considered Practically the same period of treatment (8 days) with plasmochin will free the peripheral blood of gametocytes but in neither case have we any certainty that during this period of treatment the parasites are destroyed in the deep viscera The combination treatment is therefore indicated as recommended by Muhlens[4] and others and demonstrated in our own experiences

Plasmochin is marketed in two forms tablets of 0 02 grams and also in tablets containing 0 01 grams of plasmochin combined with 0 125 grams of quinin sulphate We recommend that the latter be used as routine treatment but in acute cases this amount of quinin is insufficient, and the tablets must be supplemented by quinin Unfortunately plasmochin is toxic to many individuals and the symptoms of cyanosis nausea gastric distress methemoglobinemia and methemoglobinuria may develop and unless the drug is immediately suspended until these symptoms disappear a lethal termination may result These toxic symptoms however are counteracted by quinin hence the importance of the combined treatment Our experience justifies us in concluding that with adults the daily dose of plasmochin should not exceed 0 06 grams We have never seen toxic symptoms develop with this dosage over a period of 5 consecutive days administration, and in many cases the drug has been given in 0 08 gram doses daily in conjunction with quinin over periods up to 12 days without untoward results Patients taking plasmochin should be under daily observation and if toxic symptoms develop the plasmochin should be suspended but small doses of quinin continued This property of plasmochin necessarily circumscribes its field of usefulness, as it cannot be given out indiscriminately in large quantities for household use

In the several hundred cases treated in our hospitals, under daily thick film blood observations, by this combined method of treatment the parasites (schizonts and gametocytes) disappeared within 8 days of continuous treatment and in most cases in from 4 to 6 days There were a few relapses or reappearances of the parasites in the peripheral blood in cases suffering from abscess formations, chronic leg ulcers necessitating skin grafting, and some major operative cases These were, however, eventually discharged parasite free, with a further course of treatment

Dr O T Brosius,[6] of the Almirante Hospital Panama gave the combined treatment to ambulatory cases in his hospital dispensary and obtained results which warrant a further trial of his method

Of the 120 ambulatory cases reported by Dr Brosius treated in the outdoor dispensary, 89 were estivo autumnal, 27 tertian and 4 quartan all of whom had positive bloods His successes would indicate that the plasmochin treatment could be safely and effectively used with the cooperation of the laborers which he was able to obtain His routine treatment consisted of 0 02 grams of plasmochin and 1 gram of quinin for 4 days to all young people between the ages of 8 and 15 years Adults received 0 04 to 0 06 grams of plasmochin daily and 1 5 to 1 75 grams of quinin On the eighth day they returned for a second blood examination and four days more medicine On the fifteenth and twenty second days this was repeated

On the eighth day or the first repeated examination only 19 (15 aestivo autumnal 3 tertian and 1 quartan) out of the 120 cases showed positive blood On the fifteenth day or the second repeated examination only 4 had positive bloods all estivo autumnal infections on the twenty second day, or the third repeated exami

of the gametes we must take into account the possibility of visceral localization as Darling has repeatedly pointed out in his advocacy of quinin prophylaxis for the purpose of driving gametes from the peripheral circulation The writer is not prepared to take sides either with Darling or with those who maintain that treatment tends to force the plasmodia into the sexual cycle and bring them into field of observation Col Sir Clayton Lane in summarizing the results of War experiences with malaria strongly opposes the idea that one can at will change the infection from the schizont to the gamete stage

In our charts there was no apparent difference between the fate of the gametes in the patients who had plasmochin alone and those who also had quinin

We need now consider only the question of justification for regarding our gamete pictures as something entirely new and not heretofore observed

Senile changes in gametes have been described by the earlie t workers for example Laveran Thayer Mannaberg We have een these including vacuolization when it was the practice to examine fresh mounts We have also seen changes in stained blood whether due to quinin or not But whereas before pla mochin such pictures were occasional we here find them to be the rule I am sure that it is conceded that gametes persi t for weeks under intensive quinin treatment In our series treated with plasmochin gametes were never found after nine days continuous treatment

I do not wish to be understood as holding that plasmochin has no place in the treatment of malarial fever The tables show that in some cases it has proved quite efficacious It will doubtless be u eful where quinin is contraindicated We have used it with success in patients who refused to take quinin because of real or *alleged idiosyncrasy and to the great delight* and relief of the patients It is said to be without reaction in hemoglobinuric fever We have not seen such cases in several years Formerly we had as many as twenty to twenty five in a single season

I have omitted general citation of the literature becau e Dr Barber is presenting a summary of the results of various investigators

The concluding observations your essayist wi hes to make are that we welcome plasmochin as a valuable addition to our armamentarium especially in the interest of preventive medicine We expect to use it routinely in our hospital along the lines suggested

I believe it is now entirely feasible to require the isolation of malarial patients for ten days and release them freed of their gametes, but it seems there is not as yet a certain method for preventing production of new crops from residual schizonts Since quinin is more active upon young forms I agree with Fischer and Weise that quinin is best for after treatment

TABLE I

NO FEVER AFTER

		DAYS of TREATMENT										
		1	2	3	4	5	6	7	8	9	over	Total
TERTIAN	Quin nB s 10g t i d	14	3	3	–	–	–	–	–	–	1	20
	Sulph	33	16	7	1	–	–	–	–	–		57
	& Alkali	16	4	1	–	–	–	–	–	–		21
	Plasmochin 1	5	15	10	2	1	–	–	–	–		33
ESTIVO AUT	Qu n n B 10g t d	12	5	5	4	2	–	–	–	–	1	29
	Sulph	42	30	17	8	5	–	–	–	–		102
	& Alkal	17	7	2	1		–	–	–	–		25
	Pla mochin tam	0	0	0	4	2	1	–	–	–		7
	Co np Stab.	2	8	3	4	2	1	2	1	2	1	26
	+Qu n S lph	1	2	5	2	3	–	–	–	–		13

\+ See Explan

TABLE II

PLASMODIA ABSENT AFTER

	DAYS of TREATMENT										
SCHIZONTS	1	2	3	4	5	6	7	8	9	over	Total
Tert Pl hin 5x.02	3	9	10	5	1	2					26
& Q n g s30	2	2	3	1							7
E A Pl s noch n 5x.02	0	0	2	1	1	2					7
Comp (00 ta 15)	[illegible]	0	0	5	6	7	5	1		1	25
Pla m 1 Qu n g 30	2	5	2	0	1	1					13
										Total	78
GAMETES											
Te t Pl n 1da ly	0	4	8	7	1						20
E A Q i +	1	1	2	2	0	0	0	1			7
Plasm Comp	2	0	1	2	2	1	2	0	1		11
										Total	38

Relapsed tert an afte 17 days

TABLE III

Q inin Int ler nc Cas s

1 te ti n mala ia vomit d peatedly after quinin, took pl in plasmochin with ut discomfo t.

2 cas te tian q i in intol ranc made a g od re-c v y without symptom on plasm hin plain

TABLE IV

Toxic Symptom

1 case te ti n m l ia aft 38 tabl t pl mo hin compound piga tric b ing

1 a tertian and E A after [illegible] tab'ets plasmochin pl in a d q inin yan si

1 ca e t rtian, afte 23 tabl [illegible] plain plasmochin cyan is

1 cas tertian afte 27 t bl ts plain plasmochin, cya o i vomiti g epigastri pai

1 cas tivo autumn l after [illegible] pills plasmochin compound pyro i

the patient himself has been found so unsatisfactory as to be worthless

Another pressing problem has been that of relapses With these two exceptions quinin has been and ■ a very satisfying specific

When plasmochin was offered as a succedaneum to quinin these two therapeutic problems naturally claimed the most attention

Plasmochin is offered in two forms plasmochin plain in tablets of 0 02 gram (1/3 grain) and plasmochin compound containing 0 01 gram plasmochin and 0 125 grains quinin sulphate in each pill The former is recommended for the treatment of tertian malaria and for gametes the latter for estivo autumnal malaria

The cases here reported were studied at the Memphis General Hospital which is under the control of the clinical staff of the College of Medicine of the University of Tennessee All the patients and charts were studied by the writer in his capacity of consultant in Tropical Medicine About 800 thick and thin smears were examined in person in order to make the study authentic and reliable This study would not have been possible without the enthusiastic cooperation of the clinical staff I am especially grateful to Dr W E G Bayley for his help with the patients and histories and for abstracting the histories for tabulation I wish also to express my thanks to Winthrop Chemical Company for the generous supply of plasmochin There were 98 cases in this group but some histories had to be rejected for different reasons The list does not include cases of pernicious malaria nor some others not deemed suitable for tabulation

We had a very satisfactory background for our studies in the experiments we have been making on a small selected group each year for the past four years These experiments were made for the purpose of checking up the various individual preferences of prominent tropical workers such as the Canal Zone method the Ross plan our one time honored 10 grains three times a day (the sulphate in 5 grain capsules) and the alkaline treatment advocated by Sinton and Fletcher Our house staff is very much pleased with the modification of the old 10 t i d ' by giving an effervescent bicarbonate one half hour before each dose of capsules

The tables here presented show the relative efficacies of the two forms of plasmochin contrasted with that of quinin used in different ways They represent what we have been able to find out by studying the clinical histories and the blood smears. In the plasmochin studies alone I examined all the slides covering all check smears in thick films with ■ mechanical stage using thin smears for studying morphology Most of the quinin figures are from cases treated prior to 1927 We added a few cases of quinin treatment this year cases not deemed suitable for trial of a new remedy Our clinical material was not large enough to divide between quinin and plasmochin It was felt there was no advantage in unnecessary repetition

It must be admitted that an attempt to plan a practical treatment from a study of these tables would be difficult These combinations of treatment were chosen in part to get information as to the range of usefulness of the combinations and in part because in the estivo-autumnal series quinin had to be added in the interest of the patient

Plain plasmochin seems to be equal in potency to quinin in the treatment of benign tertian malaria It removed gametes from the peripheral blood in less than six days and in this respect it is superior to quinin On the other hand it is quite apparent that in choosing between plain plasmochin plasmochin compound and plasmochin plus quinin the practitioner is confronted with a complexity of therapeutic agents and combinations and with the trouble of determining species of parasites to guide him in his choice We have evolved a routine applicable in all cases which may be departed from according to indications We suggest that the patient be put upon plasmochin at once Quinin is added in suitable doses for the rapid control of the fever Plasmochin can be safely continued in daily dose of 0 06 or 3 tablets of plain plasmochin for 10 days without risk of toxic symptoms The after treatment is left to the choice of the practitioner with the recommendation that either quinin or plasmochin compound will be continued in full doses for 3 days of each week for a period of five weeks Although arsenic is deemed valuable it is desirable to see how well we can fare without the use of a multiplicity of remedies

The effect of plasmochin on the parasites intracellular as well as mature gametes is striking The lithographs in the paper by Schulemann and Memmi are duplicated in the slides shown in the Exhibit Hall We are not unmindful of the appearances known as quinin forms but we think we can distinguish between the two and in any case quinin form could not apply to mature gametes

In judging evidence of definite destruction

Dr Krauss (closing) —Those people who have had experience in the treatment of malaria with quinin need not seek further information as to what quinin will do to gametes no matter how many we examine this year or next year or the year after

A prominent eye ear nose and throat man requested me to announce to this Section that the amount of harm that is done by the insanely large doses of quinin formerly given with respect to bone and air conduction is incalculable and that the excessive use of intravenous injections should be condemned This also applies to arsphenamin Some physicians are rather quick with the needle especially in the use of those two drugs

Dr Deeks (closing) —This paper covers practically all of the work done last year and published in our 1926 Annual Report We have used plasmochin much more extensively this year than last One of our medical superintendents alone has treated some 400 cases of malaria with combined plasmochin and quinin keeping them under observation from six to eight months At the close of this year we expect to compile and publish another report that will show the results obtained in a large series of cases which have been observed this year The conclusions I have given you are based on observation and experience that we have gained since the material for our 1926 Annual Report was compiled for publication

I have here with me some samples of plasmochin and plasmochin compound which were furnished me by the Winthrop Chemical Company of New York City the authorized agents and distributors for the German manufacturers

A representative of this Company told me that they would furnish free of charge sufficient quantities for trial purposes to members of this Society who desire to try it out in their practice

With reference to the remarks about comparative experiments I will say that this has been done Dr Cordes of Preston Hospital Preston Cuba took a series of 72 cases of malaria half of which were given the usual quinin treatment and used as a control the other half being treated with plasmochin compound The majority of the cases in each group either had gametes in their blood on admission to the hospital or they developed during treatment In the majority of cases treated with plasmochin compound the gametes disappeared from the peripheral blood in from four to six days and with one exception all of them were free from gametes after the eighth day This one exception was free after the ninth day The opposite was true of the quinin treated cases in the majority of these gametes persisted in the peripheral blood after the eighth day and in some of them who were observed for a longer period the gametes still persisted at the end of two weeks

Patients differ regarding their idiosyncrasy to plasmochin Some of them seem to be able to take double the dosage ordinarily recommended without any disturbance whatever The untoward symptoms usually consist of either a little nausea or some gastric disturbance or a slight cyanosis of the lips Most patients can take a larger quantity of the drug than the dosage usually recommended without disturbance Others are very susceptible but all can take it if it is given under proper precautions I tell ... patients under direct observation at proper intervals can be given with safety a sufficient amount of plasmochin compound to take home with them and to last them for a period of four days They should then return in from seven to eight days for another four day treatment In nearly all cases this procedure will clear the blood of gametes and thus render them non infectious

In Ancon Hospital during the construction period of the Panama Canal we often discharged as many as 80 to 100 patients a day who had been admitted for malaria and who were free from symptoms on the day of discharge We thought we had cured their malaria Later we found by checking them up with Ross's thick film blood examination that from 8 to 15 per cent of them were being sent out as carriers of malaria With the quinin treatment we were preparing many of our patients for the spread of malaria

I think as Dr Krauss has said that plasmochin is not only a permanent additional therapeutic agent for the treatment of malaria but is one of the most valuable discoveries since the introduction of quinin

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PERNICIOUS MALARIA*

By William Krauss M D †
Memphis Tenn

First we shall take up cases of quinin fastness

One of these was a negro who persisted in having parasites in his blood no matter what we did One morning the nurse found a handful of quinin capsules under his pillow Whenever we do not get a reaction with Mayer's reagent in the urine we know quinin is not being taken There is no third way about it In such cases we give it in solution We had four patients with four plus Wassermann reaction one with urticaria who could not take very large doses and one patient with diarrhea who did not hold it in his intestinal tract long enough to have it taken up Two cases were complicated with pneumonia

When there is a complication the parasites may actually persist under intensive treatment We had two patients with pyelitis one with an antrum full of pus one case of primary syphilis with fever one of general adenopathy one with a maxillary sinusitis typhoid fever and malaria who recovered We had other cases of throat infection malaria associated with typhoid fever and other conditions We say when we do not get results from quinin in malaria that the patient is not taking it or there is some complication

We had seven patients in profound coma of whom two died and five recovered We had three patients with wild delirium two with other forms of pernicious malaria two with symptoms simulating typhoid fever and three cases of

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*Clinic ... Session Southern Medical Association Twenty First Annual Meeting Memphis Tenn November 14 17 1927

†Professor of Tropical Medicine University of Tennessee College of Medicine Memphis Tennessee

With respect to the toxicity of plasmochin, we must admit that the margin of safety is perhaps too low for general use

This is a matter that should be settled in conference by those who are in position to speak authoritatively

I have presented only a few of the highlights of the results of my studies Time does not permit my going into detail

SUMMARY

Plain plasmochin is effective only in tertian malaria and for gametes

Plasmochin compound is inferior to quinin for the control of fever in estivo autumnal malaria

We found it expedient to add quinin in ordinary therapeutic doses

Plain plasmochin in daily doses of 0 1 gram or over tends to produce cyanosis in from 5 to 10 days This was severe in one case

Plasmochin compound seems to be safe for field work and for administration in public health clinics In doses of 5 tablets daily for 10 days it will probably destroy all gametes

For this reason we think that all cases of malaria should be under quarantine restrictions until the 10 days treatment has been carried out adding more quinin if needed to control the fever

This will insure a more prolonged treatment and in this way only will operate in reducing relapses

There is the probability that plasmochin and quinin in judicious combination will increase the efficacy and reduce the cost of the therapeutic end of malaria control

Discussion follows paper of Dr Barber page 73

REPORT OF THE SUB COMMITTEE ON MEDICAL RESEARCH*

By M A BARBER M D †
Greenwood Miss

One of the most important new things in the treatment of malaria is the synthetic drug plasmochin Two members of this Sub Committee have done extensive work on its use during the past year Summaries of their work follow [1]

The experiments recorded confirm and extend the results obtained by Roehl (1926) on the action of plasmochin on malaria in birds Daily doses of 1 5 mg given orally are effective but are not easily tolerated by the birds Heavy doses of 1 0 mg and 0 5 mg given daily for five succeeding days after a single inoculation prevent acute infections but do not prevent the appearance of parasites in the blood Similarly smaller doses of from 0 07 mg to 0 2 mg given on five successive days after parasites appeared in the blood prevented acute infections but not the continuance of parasites in the blood Daily small doses of plasmochin (0 1 m) prevented the appearance of parasites in the blood of birds that were at the same time given daily inoculations of parasites Plasmochin in doses of 0 1 mg for two weeks prevented the death of birds with acute infections that were deprived of large quantities of blood The death of a bird suffering from a severe relapse was also apparently prevented by daily doses of 0 1 mg for two weeks Plasmochin is thus shown to be a very effective therapeutic agent in bird malaria It does not however destroy all the parasites in the body of the host and hence does not free the host from the possibility of relapse On this account efforts should be continued to discover a drug that will destroy all of the parasites and hence prevent what is probably the greatest single factor in the spread of malaria relapse

(The Chairman of the Sub Committee gave a few notes on plasmochin treatment in Mississippi and New Mexico A chart was shown summarizing the literature on plasmochin and plasmochin compound as used in the treatment of human cases)

REFERENCES

1 Hegner R bert The Effects of Plasmochin on Bird Malaria The Amer Jour of Trop Medicine 7 279 285 Sept 1927
2 Kraus Wm Meeting of the National Malaria Committee November 1927

DISCUSSION (*Abstract*)

Papers of Dr Deeks Dr Krauss and Dr Barber

Dr Wm E Deeks New York N Y —The Winthrop Chemical Company recently advised that they are not yet ready to place the drug on the market and would not therefore submit a price The German firm advised me that they would submit a price which would bring the cost of treatment with plasmochin a little lower than with quinin at the present market price of the latter drug

I recently bought 100 000 tablets shipped from Germany but have not yet received a bill for them

If any of you are interested in the treatment of malaria with this drug and will write to the Winthrop Chemical Company I am sure that they will send you literature and furnish you with a supply for trial providing you agree to render them a report on the results that you obtain They are very generous in that respect

Dr A T McCormack Louisville Ky —It seems to me that we should not let this occasion go by without expressing our gratitude to the United Fruit Company for its very effective scientific work which has meant much to the South and to the problem of malaria in the whole world

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty First Annual Meeting Memphis Tennessee November 14 17 1927

†Special Expert U S Public Health Service Chairman Sub Committee on Medical Research National Malaria Committee

doses of quinin intravenously All you can do with quinin is to prevent the invasion of more red blood corpuscles It is the harm the malaria has done that you have to consider In such cases certain vascular areas are completely shut off and the quinin does no good If you give alkalies you open up these areas and according to Sinton you also facilitate absorption

Another point is to obtain satisfactory elimination through the intestinal tract I think one of these fatalities might have been prevented if we had given transnasal gavage with saturated solution of magnesium sulphate

LENGTH OF LIFE OF ANOPHELES QUADRIMACULATUS AFTER BEGINNING OF CONTROL OF PRODUCTION*

By L L WILLIAMS JR MD †
Richmond Va
and
A E LEGARE ‡
Columbia S C

As summer approaches anopheles production commences long before temperature and other conditions are favorable for the convection of malaria When larvicides are used to control anopheles production as a malaria preventive measure much material is wasted in destroying early broods In many areas malarial infection in the mosquito does not develop before late June or early July whereas anopheles emerge throughout April May and June

Therefore it is important to determine the time interval which must elapse between the first larvicide application and virtual disappearance of adult Anopheles

A number of observations on this point have been made from time to time and those few made by the authors are here gathered and presented in an attempt to elucidate this point

TOANO POND VA

Toano Pond in James City County was observed to be heavily infested with larvae of *Anopheles punctipennis* during the latter part of June 1924 The breeding was confined to a rather heavy rim of floatage around the entire edge of the pond On June 30 the pond was lowered about twelve inches This stranded floatage on the bank left a perfectly clean edge and larvae disappeared from the water The usual roosting places nearby were kept under observation for the two weeks following Adult anopheles rapidly disappeared and the last one was caught on July 12 twelve days after lowering the pond For the balance of the season no anopheles were found in this area There were no other production areas within a mile and a half of this place

WARE'S POND VA

Ware's Pond in James City County was under continuous observation during the summers of 1924 and 1925 In 1924 the pond was raised considerably prior to the breeding season and then lowered about the middle of June This cleaned the bank and no anopheles larvae were found in the pond Early in September the miller replaced the baffle board in the spillway raising the water into the grassy edges and two weeks later anopheles larvae appeared among this grass One week later adults took the wing and were found roosting in the nearby sheds hen houses and pig sties In other words two weeks after conditions were favorable larvae appeared and three weeks after conditions were favorable adults appeared

The following year (1925) the pond was in excellent condition until August At that time the dam washed away Upon its repair enough water flowed into the pond to raise the level just sufficiently to resuscitate some aquatic growth which was a very excellent harborage for anopheles larvae Seven days later larvae appeared among this growth and in sixteen days adults were on the wing

LAKE PRINCE VA

Lake Prince in Nansemond and Isle of Wight Counties Virginia was under continuous observation during the summers of 1924 1925 and 1926 The salient observation was made during August of 1924 as follows

On August 20 the flood gates were opened and the lake level began to fall Floatage and most of the larvae were stranded almost immediately Within a few days all larvae had disappeared from this lake The roosting adults were caught in a negro house and adjoining stable as follows

Date	No Roosting Quad
Aug 0	135
Aug 4	3
Aug 7	17
Sept. 3	13
Sept 11	5

*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty First Annual Meeting Memphis, Tenn November 14 17 1927

†Surgeon U S Public Health Service

‡Sanitary Engineer State Board of Health of South Carolina.

abortion due to malaria. One of these patients died because malaria was not suspected

A negro boy aged 10 well nourished was unconscious for twenty four hours We gave him 100 c c of 5 per cent alkaline glucose solution intravenously twice He was in the pediatric division and they do not like to give quinin intravenously They gave it intramuscularly two doses The patient recovered consciousness and finished treatment orally

A white man aged 63 was picked up in a comatose condition Tertian parasites were found He was given two doses of five grains each intravenously because he could not swallow After consciousness was restored we were able to complete the treatment by mouth This was interesting because the delirium and coma were apparently due to the tertian parasite

It is not our custom to give quinin intravenously in large doses or at all, if we can help it If you have a patient in an asthenic condition and give 15 grains intravenously you are almost sure to have a death I have seen three deaths like that in the last three years Dr Maxcy of the United States Public Health Service studied a number of cases that were being treated here at the Marine Hospital and found the blood pressure depressed alarmingly after 15 grains intravenously If you give smaller doses and repeat them you have no trouble

A negro patient in wild delirium required massive injections of morphin ice cap and salts to control him but he finally became rational On inquiry we found he had fallen out while throwing a ball at an amusement park and it was believed that he had meningitis Blood examination which is done routinely showed that he had pernicious malaria After he regained consciousness he could swallow and he recovered under the usual treatment

A white man aged 19 with double malaria was admitted in coma He could be aroused to take his medicine and finished satisfactorily on the routine treatment without any difficulty We learned later that this was his third chill We think such rapid development of perniciousness after three chills is a recrudescence of latent malaria

In the fatal group both patients were asthenic, and made no response to any form of stimulation There was no marked degree of pyrexia One of them died in eleven hours and one in fifteen

The first patient was a white man aged 24 His brother informed us that he had had malaria for six months A week before a mule had kicked him and caused a fracture of the radius which had never been reduced and that was the beginning of the pernicious phase His temperature on admission was 101 F and he was in typical asthenic coma All kinds of symptomatic treatment were employed without the slightest result Quinin was given intravenously in safe doses frequently repeated

The other patient was a white man perhaps 60 years old who was picked up on the street in a typical asthenic coma He had an old osteomyelitis of the knee and a heavy infection of estivo autumnal malaria All kinds of symptomatic treatment were employed to hold him up until quinin could get in its effect but without result He died in eleven hours. These were really cases of agonal coma and probably no results could be expected by any method of treatment.

We think an intravenous injection of sodium bicarbonate opens up the blocked vessels and allows the solution to have more effect One thing to remember is to give these patients alkalies even if you do not do anything else We think this accounts for the recovery of some of our desperate cases

In one case that of a white man aged 50 the temperature did not rise to normal until the third day after admission He gave a history of quotidian malaria with vomiting diarrhea cold clammy skin and very faint pulse This patient was conscious and rational which is always the case with this algid type of patient On account of vomiting he was given five grains of quinin intravenously every three hours for three doses and then received it by the routine method Alkalies were pushed to the limit and this patient made an uneventful recovery

Another case of the gastro intestinal type was admitted with a bilious fever These patients have usually been sick a long time before they reach the hospital and often terminate fatally on the first day If we can hold them for twenty four hours we have them saved This case shows the prompt effect of alkali treatment for there was a complete clearing up of gastro intestinal symptoms and the patient made a rapid recovery

One patient was brought in with hiccough We do not know yet what the cause of the hiccough was but we examined the blood and found malarial parasites We cured the malaria and the hiccough subsided Whether it was due to the malarial infection or subsided spontaneously I am unable to say

A colored woman was admitted to the Gynecological Department of the hospital following abortion Gas gangrene was suspected The woman was apparently toxic jaundiced the urine was dark and smoky and she was comatose While Dr Michelson was taking blood for the culture he made a smear and found an abundance of estivo autumnal parasites He gave her quinin intravenously with some glucose followed by sodium bicarbonate and although this woman looked as though she would die within a few hours she recovered

The malaria was the original cause of the abortion and was not recognized until she became comatose The Welch bacillus symptoms were due to malaria We lost one white woman with such a history and saved another

On the surgical side we are just getting the reverse of the attitude we used to have twenty five or thirty years ago when we treated everything as malaria

Many cases of comatose malaria and other pernicious malarias are allowed to end fatally partly because we fail to make a proper diagnosis partly because we do the wrong things The one great wrong is to give immense

The above tables show that subsequent to the day of dusting (i ■ the day of larval extermination) a period of sixteen days could have elapsed safely before the second dusting and yet have controlled production from this pond It is also shown that following the day of dusting the adults had practically disappeared in nine days and were still scarce sixteen days after dusting

CONCLUSIONS

These observations in general indicate that larval control need not commence earlier than ten days prior to that date on which adult control is necessary At the end of the season larvicide need not be applied later than two to three weeks before that date after which adult control is no longer necessary In other words if epidemiological evidence has shown that conditions are not suitable to the convection of malaria prior to say July 1 then larval control need not be practiced earlier than June 20 If temperature conditions are no longer suitable to the convection of malaria by October 15 then September 25 is the latest date on which one need apply larval control measures

DISCUSSION (*Abstract*)

Dr M A Barber U.S.P.H.S Greenwood Miss—Last ummer in northern New Mexico we did an experiment to determine the growth rate of anophel ne larvae in the comparatively cool waters of that reg on By means of Paris green we thoroughly destroyed the anopheline larvae of a certain lagoon Then at frequent intervals we revisited the place and made collections of the new broods of larvae to determine the growth rate and increa e in numbers As a further check on anopheline production we used a trap for adult mosquitoes cons sting of a barrel sunk in the bank of the lagoon The slow growth of the larvae indicated that in these waters fully two weeks would be required for the growth from egg to adult mosquito and that probably a Paris green treatment twice a month would suffice even in midsummer for the control ■ anopheline breeding in this lagoon

MALARIA SURVEY IN IRRIGATED REGIONS OF RIO GRANDE RIVER NEW MEXICO*

By M A Barber M D †
Greenwood Miss

Two regions were surveyed during the summer of 1926 and 1927

(1) A region near Espanola northern New Mexico with an elevation of about 5 600 feet above the sea There malaria has been endemic for many years A high endemic index occurs in certain villages principally among Spanish Americans and Pueblo Indians Only the benign tertian type has been found there

(2) A region in southern New Mexico elevation about 3 800 feet where malaria has considerably increased during the past three years Many cases occurred during the late summer and autumn of 1927 Both benign tertian and estivo autumnal types were found

In both regions anopheles are very abundant The chief breeding places in the northern region are ancient beds of the Rio Grande and wet pastures or meadows supplied with water from irrigation ditches in the southern region in drainage ditches dug to prevent oversaturation of the soil with water

Drainage of a comparatively inexpensive type would effect a great reduction in breeding places in the wet pastures and ancient river beds The removal of aquatic vegetation would much reduce the production of anopheles in the drainage ditches a remedy very expensive and at best temporary The use of Paris green would be feasible in all of the breeding places along the Rio Grande in New Mexico Gambusia seemed to be absent in most of the valley We introduced two species during the summer of 1927 One species had begun to multiply in September

A large percentage of the dwellings in both regions are screened The use of quinin is probably not so common as among people in the malarious regions of the Southern and Southeastern states The further encouragement of early treatment of cases would probably materially reduce malaria in the Rio Grande Valley

It is evident that malaria must be taken into account in the development of reclamation work in the arid regions of the Southwest

Our survey is part of a general study of the problems of malaria in the irrigated regions of the southwest A more extensive publication will follow

DISCUSSION (*Abstract*)

Dr T H D Griff its Biloxi Miss—Dr Barber spoke of the type of malaria in the upper area as being estivo-autumnal and in the lower o e ben gn tertian Did there seem to be a relation pronounced or otherwise between the preval nce of a certain pecies of anopheles and the species of parasites found?

Mr J A Leprince Sen San. Eng U.S.P.H.S Memphis Tenn—I should like to ask Dr Barber whether

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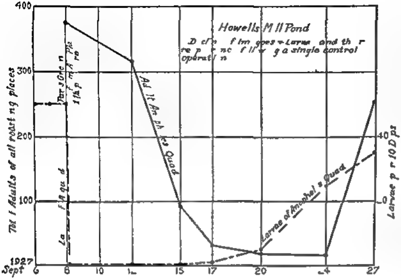
*Ab tract of paper read b fo the Natio al Mala ia Committe m ti g conjointly with South rn Medical A sociati Tw ty Fi t A al M ting Memphis Tenn ee No mber ■ 17 ■ 7

†Special F pert L S Public Health S rvic



Decl ne of Imago s after larval control

number of larvae in the water, the disappearance of both following a control operation and the return of both subsequent to cessation of control measures These conditions are fulfilled in the last and most important observation, which was as follows

HOWELL S MILL POND, S [redacted]

Howell s mill pond, in Bamberg County South Carolina is a small impounding of 500 acres in a nearly uninhabited part of the country Trees and brush were never cleared from the basin prior to raising the water Breeding of *Anopheles quadrimaculatus* was excessive, and adult infestation in the roosting places near the dam was very high On September 8 1927, this pond was used for a demonstration of the feasibility of controlling production by means of Paris green applied from an airplane in spite of heavy vegetation The pond was dusted with a pound of Paris green to the acre with entire success

Subsequent to the dusting, regular observations were made of roosting adults and regular dippings were made in the pond for a period of time with the following results

	1		2		3		4		5		6		7		Total Anop
	m	f	m	f	m	f	m	f	m	f	m	f	m	f	
9 1?		45	1	1	34	6	5	13	9	6	35	21	15	5	315
9 15	14	10	0	0	1	6	5	3	3	1	0	8	4	1	67
9 17	3	0	1	0	0	1	1	0		4	3	12	5	2	34
9 0	3	0	0	0	0	0	0	0	2		3	5	3	3	1
9 24	1	0	0	0	2		1	0	0	0	4		3	2	18
9 7	5		5	4	2	1	10	6	1	3	60	49	0	37	6

No 1—Hollow T e—25 W B idge
N —Under B idge—We t Side
No 3—Under Bridge—East Side
No 4—H llow T e— 5 East Bridge
No 5—Spillway—West Side
No 6—Spillway—East Side
No —Spillway—Cent r Beam

Turned cool on Aug [redacted]
Cool Aug [redacted]
Warm Aug 25

Tabl of dips made

Date	No A larva per 10 dips
S pt 6	50
8 a m	50
8 p m	0
10	0
1	0
15	0
17	2
0	5
4	25
7	35

QUANTICO VA

At Quantico Virginia, during the summer of 1926 airplane Paris green dustings were successful in controlling production of *Anopheles quadrimaculatus* There was one break during the middle of the season Quantico Bay should have been dusted on August 10, but was not dusted until August 17 On that date for every four larvae taken one pupa was caught These hatched and produced a moderate infestation throughout one half of the camp This infestation of adult mosquitoes lasted almost exactly ten days

It is interesting to note that this infestation appeared on August 19 the effective control measure prior had been applied on the fifth That means that adults reappeared fourteen days after the last effective dusting

DISCUSSION

The above observations though incomplete indicated that following control measures the adults present disappeared in ten days thirteen days and twelve days respectively, that larvae returned in quantities to the breeding ground in seven days and fourteen days respectively adults reappeared after the last application of control measures in fourteen days sixteen days and twenty one days respectively The most important fact is that after cessation of control measures adults may be expected in two to three weeks None of the above observations was complete in that at no single place could we observe the relation between number of adults and

taking the measurements the exact number of inches in width and height was recorded on the diagram to represent the size of the wire screen to be cut to fit over each window

All doors were made to hang and swing out ward from the house They were hung on the outside of the regular door facing allowing a 1 inch lap on each side and a 1 inch lap at the top and flush with the floor at the bottom When the screen door was properly hung it was encased with 1x1 inch strips around the top and facing thereby making a closely fitting screen door

The majority of houses measured were slightly sagged and in order to get the proper measure ments a plumb bob was dropped from one side of the door and the measurements in inches from the bottom to the top of this plumb bob line were taken which insured a screen door of the desired size to cover the opening and also al lowed for the lap

This method of house measurement proved very satisfactory A total of approximately 20 000 doors were made and hung in the flooded area There were 10 238 of this number made in Greenwood and used in the Mississippi Delta east of the Mississippi River The others were made in Arkansas Tennessee and Louisiana and hung in the Delta sections east and west of the Mississippi River Up to this time there have been no suggestions for improvement to warrant the changing of this technic of tenant house screening

Method of Handling Doors —After each door was made it was labeled with the house number and a letter corresponding to a similar number and letter on the diagram which designated the opening the screen door was to cover

The screen doors were made up in carload lots and shipped to each county This greatly facili tated transportation and storage

The timing of the field workers in taking the house measurements in Mississippi and factory workers in Greenwood in making up the doors was so accurately calculated that within four days after the measurements of the last house had reached the factory the entire group of doors had been completed loaded for shipment and the creen door factory closed down

Door Factory Routine —The clerk copied on a typewriter each individual door measurement from each house diagram u ing small pieces of strong window shade cloth in sizes 2x4 inches on which was typed the name of the county the plantation the tenant number of the house the letter indicating the position of the door, the size of the door in inches width and height and the word right or left' indicating the side of the screen door on which the hinges should be placed

These identification tags were kept together in numerical order so that the carpenters when cutting the door frame could keep the door frame in proper order and the doors would not be mixed up at the factory One of the tags was tacked on each door frame so that the screen door might keep its identity from the time con struction started until it was hung on the house for which it was intended

Cutting the Lumber —The sawyers selected the lumber using choice traight lumber for the long or side pieces top and bottom pieces and the less perfect lumber for the cross bars

The ends of the top and bottom pieces and the long or side pieces were cut in a miter box at an angle of 45 degrees according to the num ber of inches in length and width as shown on the identification tag

The average number of door frames that one man could saw in an average day under normal working conditions was about 100

Assembling the Door Frame —These door frames were assembled on metal surface tables the door frame being held in position by four sets of wedges The cross bars were cut and added after the sides top and bottom of the door frame had been assembled thereby assuring the tightest possible fitting joints for the cro s bars

The lower cross bar was spaced 18 inches and the upper 36 inches from the bottom

Sheet metal triangle plates 24 gauge thickness were nailed on the corners of the doors and smaller plates one-half the size of those used on the corners fastened the cro s bars to the door frame

Screening the Door Frame —The unfinished door frame was taken from the metal top table and placed on a supply rack later to be moved to a hard surface table at the end of which was installed a rack to hold wire screen When the door frame was in proper po ition on this table the wire screen could be drawn from the roll and tacked on the top of the screen door frame

By special arrangements of wedges the wire creen was drawn tight and held in this taut posi tion until it could be properly tacked to the

the soil in the bottom of the drainage ditches was muddy or sandy

Dr L L Williams Jr Surgeon USPHS Richmond Va—What is the length of the breeding season in that section and what do you estimate as the season for malaria convection? With two hundred miles of ditch with the use of the aeroplane the number of dustings you have to put on is a matter of tremendous importance

Dr Barber (closing)—The soil of the region in southern New Mexico described is sandy and the water in the drainage ditches is about 2 to 3 feet in depth clear and in many places rapidly flowing *A pseudopunctipennis* is the anopheline species most common in the portion of the ditch exposed to the sun while in the vegetation shaded margins *A maculipennis* prevails

The pecies of anopheles and character of breeding place in the region of southern New Mexico where benign tertion was mo prevalent were essentially the same as that found in the estivo autumnal region Apparently the pre ence of the one or the other type of parasite depended on the carriers from whom the infection spread rather than on the environment or mosquito pecies The county health officer believed that estivo autumnal malaria was introduced by certain carriers from Oklahoma and Texas Our examinations were made in August and September the season in which e tivo autumnal malaria is most common in the Southern states generally It will be interesting to determine what type of malaria will be most common in relapsing cases next pring

The warm season in southern New Mexico is relatively long beginning in May and extending throu h September

METHODS AND COSTS OF SCREENING FARM TENANT HOMES IN MISSISSIPPI*

POST FLOOD MALARIA CONTROL

By C P Coogle M D †
Greenwood Miss

The method of post flood malaria control chosen by the American Red Cross officials and public health officers was to screen those houses in and adjacent to the flooded area which were found to be housing malaria cases and potential malaria carriers A big problem of detail had to be worked out Calculations of the quantity of materials, of the labor cost and the time for construction were based on the scheme worked out and published by the U S Public Health Service[1] from experimental work conducted in Le Flore County, Mississippi, during the three previous years This work covered a total of 104 houses accurately measured and carefully observed

As would be expected there were certain local problems peculiar to the flooded sections of the states of Mississippi, Louisiana, Arkansas and Tennessee, and in this paper it is intended to discuss only some of the most important factors common to the entire territory

The same scheme of selecting houses to be screened was adhered to in the entire flooded area The number of houses per county was not equal and there was a marked difference in group selections in each county where the work was undertaken Even though the percentage of homes screened was low as compared with the malaria problem the screening scheme did strike at the very heart of the malaria foci and much relief was given

The respective health officers assumed the responsibility for group selections, based on information of malaria prevalence, and the house selections were as well made in one county as in another

The technic of selecting houses to be screened was to visit the communities in which from previous information the health officer had good reason to believe that malaria was prevalent or was more prevalent than in other communities A visit was then made to the owner or manager of the plantations and explanation made of the purpose of the selective screening that is to screen houses in which there were malaria cases or suspected malaria carriers With the assistance of the owners and plantation managers homes were visited, tenants were interrogated and the screening decided upon

Diagrams were made of the houses showing the location and size of each window and door and the relative position of the doors to the house on which they were to hang

Wire screen was placed on the outside of the windows the full length therefore in taking measurements for the windows there was allowed a 1 inch lap at the top a 1 inch lap on each side and a 2 inch lap at the bottom It was through this lap that the wire screen was tacked to the window frame with No 4 canvas tacks spaced about 2 inches apart on the two sides and across the top and two rows of tacks spaced about 2 inches apart across the bottom In

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*Abridgement of a paper read before Nati nal Malaria Committee (Confer nce on Mala ia) meeting con jointly with South rn Medi al A ociation Twenty Fi t Annual Meet ng M mphis Tennessee Nov m ber 14 17

†Acting Assistant Surgeon U S Public Health Service

1 Reprint 1153 pp 1101 111 from Public Health Reports April 19

was done could boast at that time of a full time health unit This was Ouachita Par h where the Director of the Health Unit selected the houses to be screened The field bacteriologist for the Louisiana State Board of Health was located at Monroe at that time and was supervising the work of local Red Cross inspectors who had been appointed for a month s work His offer to see the various health officers and use the Red Cross inspectors in locati g the malaria carriers was ac cepted Several different methods of selecting the houses were followed

In Ouachita Parish the physician and his nurse made a plantation to plantation and house to house survey callin on the plantation owners expla n ng the screen in, and malaria transmission and securing assi tance in locating malaria carriers on the r plantation living in homes that could be screened

In Richland Parish the names of malaria carriers were secured ■ the offices of phys cians in the parish together with information as to plantations on wh ch they l ed the road distance and direction from town Th s information was then sorted out according to roads on wh ch the houses were located

In some of the other pari hes the hou es were picked by the local Red Cross inspectors under the direction of the part time health off cer after the work had been explained to h m by the State Board of Health repre sentative who had offered to obtain this list

Screening Windows—The fir t main difference be tween our Louisiana pro ram and the one in Mississippi was the fact that we carried on the entire pro ram in the eight parishes in exactly the same manner as in the parish in which our factory was located As in Leflore County the first operation after securing the list of hou es to be sc eened was to send out a crew of three or four boys with various widths of screen wire in their truck together with all tools and hardware necessary for the creening of the w ndows At the same time the house door measurements were taken This enabled the boy in charge who made the house sketch to ex plain to the tenant the purpose of the screening the fact that they were takin measurements for doors to be constructed in Monroe and when they might expect to get the doors to compl te the work As soon as the scene of operation changed to other parishes besides Ouachita where the screen door factory was located it became necessary to pay living expenses of the men which automatically changed the scale of wages from $2 50 per day to $5 00 a day However the usual method was to send two boys instead of the three or four and ■ hire inexperienced boys at $2 50 a day in the towns from wh ch they operated

When working in Madison Tensas East Carroll and West Carroll Parishes the workers were a distance of from sixty five to one hundred and forty miles out from Monroe Three of these parishes are on the Mis siss ppi River wh ch is about e ghty five miles from Monroe ■ order to get to one of the parishes, namely East Carroll it was necessary ■ go east from Monroe about forty five miles then north into Arkansas and then northeast in Arkansas over some dirt roads then south again ■ Lake Pro idence a total di tance of approximately one hundred and forty miles Over 40 per cent of the houses which we screened were located in these four parishes

Dr Coogle stated that from twenty five to forty house measurements for screen doors and the screening of the windows on these houses by a carpenter and two assistants was an average day s work under normal con ditions " In Louisiana I think the best that a crew of three men was able to do was twenty five houses in one day The ■ twenty five houses were located on the main h hway and very little time comparatively speakin was lost between houses although the local Red Cross in pector went with the boys and interviewed the plantation owners and located the hou es to be screened on that same day and assisted with the screen ing work whenever possible On some days not more than one or two hours were spent in actual screening work the other e ght or nine bein pent in d gging out of the mud

Door Construction—Fortunately in Louisiana the Superintendent of the Louisiana Training Institute at Monroe became very much interested in the work when it was explained to him by Mr LePrince and myself He offered to use his boys to build all the doors for us without cost to the Red Cross if we would furnish tables and materials A group of boys at this school ■ de tailed to do all the carpenter work ■ the school under the direction of a professional carpenter and this group together with their instructor was deta led to build the doors The direction of the shop was left largely to the instructor as he was exceptionally interested in the work After about three weeks work by this crew of seven boys the school barn was partially blown down by wind and for several days no work was done at the shop As the repair work on the barn would take several weeks another instructor was placed in charge of the shop and a new crew of boys was broken in Toward the close of the work it was found necessary to peed up and the crew was increased to fifteen boys On some days as many as eighteen boys were working who would turn out approximately one hundred and twenty five doors per day

So far as the shop and equipment was concerned it was very similar to the M ssissippi shop in fact copied after it But our door d ffers slightly from the Mississippi door because the top of our pu h bar is 41 inches from the bottom of the door As the work neared its close I had the opportun ty of a vis t to the Dyer burg factory in Tennessee and later used two de vices which they had developed for speeding up the work on the table where the screen wire ■ tacked to the frame

Delivering the Doors—As the factory room was very small ■ was necessary to deliver the doors almost as fast as they were built The usual procedure was to sort and check the doors on the lawn just outside the factory and load the truck in the late afternoon The following mornin the truck would start out early and the day was spent in delivering doors from house to house This work proceeded qu te rap dly when the houses were within thirty to fifty miles of Monroe but when they were at a greater distance ■ was necessary for the boys to stay overnight and this of course meant living expenses in add tion to their regular salary For example one boy started out early Tuesday morning with a load of doors to be delivered in East Carroll Parish This was our longe t haul, being nearly one hundred and forty miles I expected that possibly a few of the doors would be delivered that afternoon but received a wire the following day ■ ten o clock stating that he had just arrived in Lake Providence and would start work immediately The load consisted of about seventy doors No word was heard from him Thurs day but late Friday n ght he called by long distance phone from Eudora Arkansas stating that he had burned out a connecting rod and the repairs would cost him $7.50 He had $5 00 in his pocket left from $35 ex

door frame with tacks spaced about 2 inches apart

Metal triangular plates were placed on the four corners of the door and at the junction of the cross bars on the wire side, and all were nailed securely Two sizes clout nails were used During the first operation when the plates were put on the front surface of the door 1⅛ inch nails were used This length permitted the points of the nails to clinch against the metal surface of the table Shorter nails one inch long were used in all metal plates on the back surface of the door

Lumber—The lumber used in screen door con struction was No 1 cypress 1 inch thick and 3 wide surfaced only on one side The smooth side was placed on the outside and the wire screen was placed on the back or rough surface of the door

In hanging the door 3x3 inch loose pin butt hinges were placed 12 inches from the top and 12 inches from the bottom of the door One inch by 1 inch strips were used to enca e the screen door

Labor—The output of the screen door factory was from 200 to 300 doors per day

The number of men employed at the factory ranged from 17 to 22 and the minimum salary paid was $2 50 per day The maximum was $4 50 per day, depending upon the kind of work to which the men were assigned

Extra work was offered the men on a piece basis of 23 cents per door for all doors that were made above 200 which was specified as a day s work This scheme assured that 200 doors would be made each day and each man was enabled to add from 50 cents to $2 00 per day to his earnings by working more hours

Metal Corner Pieces—The galvanized sheet metal plates that were used on the corners of the doors on the front and back surface and also used to join the cross bars to the door frames were cut from long strips of 24 gauge double plated galvanized sheet metal They were cut into small squares 6x6 inches and these were sheared diagonally into triangles The smaller metal plates were triangular in shape and one-half the size of the larger corner plates

Costs—The cost of the lumber delivered at the factory averaged 47 cents per door The hanging strips averaged 10 cents per door The cost of the 1x1 inch strips to encase the screen doors averaged 4 cents per door The cost of the clout nails was in the neighborhood of 1 cent per door The cost of the common nails to fasten the strips to the door casing was about 1 cent per door

Cost of Hanging Doors and Screening Windows—The average labor cost for hanging creen doors in LeFlore County was 35 cents each The average labor cost for screening windows in LeFlore County was 5 cents each

A large proportion of the doors was hung by carpenters who received from $2 50 to $4 50 per day Several hundred doors were hung by con tract at 35 cents each

Practically 90 per cent of the windows that were screened in LeFlore County were screened during the time that the house diagrams were made, and the average labor cost was about 4 cents per window

Several hundred windows were screened on a piece basis at the rate of 8 cents per window where the carpenter furnished his own trans portation

In one instance a fairly good, reliable negro carpenter earned $40 70 in eleven days hanging 90 doors at 35 cents each, and screening 115 windows at 8 cents each

COST OF MAKING ONE SCREEN DOOR IN MISSISSIPPI

Hardwa e			
W e screen	$0 444		
Metal plat	0 0 9		
Clout nail	0 009		
Tack	0 007	$0 539	
Lumb	0 4 0	0 470	
Labor	0 240	0 240	$1 249

COST OF HANGING ONE SCREEN DOOR IN MISSISSIPPI

Hardwa e			
Hing	$0 08		
Sp ng	0 0		
Doo pull	0 0		
H ok and ye	0 01		
Screws	0 0 1		
Nails	0 01	$0 191	
Lumber	0 30	0 30	
Labor	0 350	0 350	0 771

Total t const uction and hanging one door $2 0

DISCUSSION (*Abstract*)

Mr Alfred H Fletcher New Orleans La—On July 11 I went with Mr J A LePrince to Greenwood, Mississippi to study methods and specifications for building screen doors and screening farm homes as worked out by the United States Public Health Service in Leflore County Two days were spent at the shop and in the field with Dr Coogle who explained in detail every phase of the work Therefore our program in Louis ana was patterned after the Mississ ppi work

As in Mississippi the responsibility of selecting houses to be screened was placed on the health officer in each parish Only one of the Parishes in wh ch screening

A little different method of numbering was followed from that described in the paper in that the doors for each house were numbered 1 2 3 etcetera and this number was supposed to be chalked on the door casing or side of the house adjoining the door at time of measuring. At headquarters the doors were given a serial number irrespective of the county. During construction each door was tagged showing the county, owner, house occupant, house door number, size of door and the serial number of the door. In addition the serial number was chalked with black crayon in large figures on the door frame. When the doors were shipped a list showing the serial numbers for each plantation was forwarded the inspector.

Shipments were made in carload lots, the entire shipment for any one county including all screening material being made at once. Since the greatest number of doors to any one county was 617 one car per county was all that was required.

Under the plan of field work that was followed and followed from necessity not choice, all the preliminary field work was completed at about the same time causing in most instances a considerable loss of time between the completion of the field work and the start of actual screening.

Under the original plan all screen doors were to be made by the inmates of the Arkansas Boys Industrial School located near Pine Bluff without charge for labor. This school had a large roomy wood working shop well equipped with wood working machinery and a sufficient number of older boys ranging from 1 years to 21 years to have allowed for a maximum production within the limited time available. It was planned to construct 10,000 doors, the time limit for completion begin September 1. Material sufficient to construct between five and six thousand doors was delivered at the school and we were ready to begin operation on a full scale July 5. Up to the last week in July 1,076 doors had been made and it was very evident that the school had no intention of completing the number of doors required within the time set and that not more than three thousand doors would be completed by September 1. It became necessary therefore to equip a shop, train a crew and build the doors ourselves. Since no appropriation was made for labor it was necessary to reduce the number of doors to be made and to apply the saving to labor costs. This made it necessary to reduce the county quota of houses accordingly.

The shop was started on August 1 and was operated for 25 days during which time 6,228 doors were constructed making the total doors constructed 7,304. After the first week, which was largely a training and coordinating period, the shop was in full swing. Twenty six young men were employed at the rate of $ 50 per day on an eight hour basis. The actual working time per day was 7 1/2 hours as a 15 minute recess was taken at 10 A M and 3 P M each day. With these recesses we were able to maintain a constant speed and it is believed that more doors were constructed per day than would have been the case with continuous work. After the first week a lower limit of 250 doors per day was set. The average however actually ran 276 exceeding 300 on some days and reaching 3 as the maximum.

The equipment was practically the same as described by Dr Coogle as was also the line up of the men. One exception was that the metal reinforcement plates were punched for nail holes and the corners bent at right angles before they were delivered to the framing tables. It required f e men for this work. It was found that in nailing the plates to the frames there was a tendency for the sharp points to stand away from the wood by turning these points down at right angles to the plate they could be driven into the wood not only offering a protection from these sharp points but also holding the reinforcement triangle in place while it was being nailed.

In the construction of the doors the upper cross bar was placed somewhat higher than was the case of the doors made in Mississippi. This bar was placed so as to allow 20 inches between it and the lower bar or 41 inches above the bottom of the door. This seemed to be about the average height necessary for protection of the screen wire when the door was opened by pushing with the hand and was at the height that would protect the screen wire when the door was opened by pushing with the side of the arm, in this case the bar striking the arm between the elbow and the shoulder.

The material for the door frame was of clear cypress dressed two sides to 31/32 inches. The facing strip for the hinges as well as the 1 inch facing strips were dressed one side to a thickness of 33/32 inches, the rough side going against the house.

The lumber was purchased as five quarter inch rough by broad at a delivery price of $30.00 per thousand. Milling and stripping to the 3 and 1 inch widths cost $6.00 per thousand which included delivering from the mill to the shop which was located in a storage shed of the mill. This brought the total cost of the lumber delivered ready for use to $36.00 per thousand. The average amount of lumber necessary for the door construction as well as the facing strips and the small amount necessary in connection with the window screening was 14 board feet rough lumber per door. In purchasing lumber rough by board the waste is of course much greater than where definite length pieces stripped and dressed are purchased since there is the waste in sawing and milling as well as the waste due to the varying lengths. This increase in waste however was in our case far offset by the low cost at which the lumber was obtained. Dr Coogle gives the average lumber cost as 0c per door whereas our cost was 49c per door.

The other material used in the door construction was similar to that described in the paper except that with 31/3 inch material it was necessary to use $1\frac{1}{4}$ inch clout nails in order to obtain proper clinching.

In loading cars the doors were laid flat in stacking each stack being as far as possible of approximately the same width doors. The facing in which the hinges were attached was nailed to the door frame for shipping. In stacking in the car therefore each door was reversed so that there was approximately 1 4 inch space the thickness of the facing strip between the wire of each door. This prevented tearing of the wire mesh and with the proper bracing allowed the shipment to go through without damage. In fact we had no reports of screens that were damaged in transit.

The screening material for each county was shipped to a central distributing point where arrangements were made with the local Chapter of the Red Cross to have the cars unloaded, the material sorted and stored. This was done under the direction of the county inspector and where possible one of the officers of the Public Health Service assigned to the work was also present.

No arrangement was made in the original plan for the distribution of the material to the respective houses and it was necessary therefore to depend upon the plantation owner or house occupant to call for the

pense money advanced to him before he left Monroe It was nece sary to wire him $10 00 to pay for board and room and he reached Monroe about three o clock Saturday afternoon In addition to that he had had a spare tire tolen had lost off eight doors on his way over without knowing it and had had other car trouble also tire trouble This tory i told not only to how that the transportation expenses were considerable but that delays from car trouble and so forth meant an in crease in expense for meals and room as well as salary

Sheet Steel Plates —The original plan was to have these plates cut in Pine Bluff Arkansas as the labor and use of squaring hears at the Training School would be free However the factory was changed from the school and it was necessary to ship the sheets to us at Monroe We rented squaring shears in Monroe and cut the trian les our elves Dr Coogle s average cost of metal triangles was 8 cents per door set Our cost was 13 ▮ cents

Lumber —The cypre s lumber co t $65 00 per thou sand board feet which made a cost of $0 55 per door against $0 42 per door in Mississippi The cost of han ing strips and encasing strips was $0 19 per door in Louisiana and $0 14 a door in Mississippi We used sixteen foot len ths altogether in Loui iana and found the total waste to be very small

Nails —The cost of clout nails was $8 50 per hundred pounds in Louisiana against $7 50 per hundred pounds in Mississippi We were able to keep a supply of 7/8 inch clout nail but had to use three penny nails in place of 1 1/4 inch clout nails for at least two weeks

Hanging Doors —The average number of doors which two men were able to hang in one average day in Loui siana was from thirty to forty In other words a car penter and a helper would hang doors on ten houses for an average day s work This seems to agree fairly closely with the Mississippi avera e of fourteen doors for one man in one average day

Comparison of Unit Cost —The average labor co t of hanging screen doors in Leflore County was $0 35 per door The average cost in Louisiana was $0 357 plus $0 147 per door for meals and room plus $0 216 for transportation The average labor cost for screening a window in Leflore County was $0 05 in Louisiana it was $0 25 for labor $0 069 for meals and room and $0 15 for transportation This unit cost of screening windows al o includes the cost of measuring doors

C mp n f C ts f M t l d L bo F C n tru t n f S n Do in M pp d L na

	Mi is pp	Lo isi a
Hardw		
Sc een W	$0 444	$0 515
Steel Plat s	0 079	0 13
Cl ut N l	0 009	0 019
Tack	0 007	0 012
	0 539	0 6 8
Lumb	0 470	0 553
	0 240	D ated
C t P Doo	$1 49	$1 31

C ts f M t l And Labo F r H g g S e D In Miss ssipp d Lou

	Mis iss ppi	Lou
Hardwa		
H nges	$0 08	$0 100
Sp ngs	0 05	0 060
Doo Pull	0 0	0 015
Hook d Eye	0 01	0 014
S w	0 0 1	0 0 5
Na l	0 01	0 007

	0 191	0 211
Lumber	0 230	0 191
L b r	0 350	0 450
	$0 771	$0 85

T t l Co t f Co t u t n and Hang g per door
n M ss ppi $ ▮
in Lou ana $ 083

In Louisiana we screened 653 houses at a cost of $13 90 a house

R E Tarbett United States Public Health Serv ice Little Rock Ark —In general the plan of carrying on the screening of farm tenant homes in the flooded districts of Arkansas was similar to that in Mississippi The general plan of work as recom mended was modified in some of the essential features without the knowledge of the originator of the plan. That these modifications had been made became evident only after the work had been authorized and appropria tions made These modifications made the carrying on of the work more difficult less efficient and more costly than would have been the case under the plan recom mended

The methods followed in the selection of the houses to be screened was not a satisfactory one although it did allow for a rather wide distribution of screening within the counties selected In only one of the sixteen counties within which work was carried on was it possible to rely on the county health officer to select the houses to be screened In the other counties we were obliged to depend upon a local inspector one to each county em ployed for a temporary period and given about two days instruction with very little follow up The pay of these inspectors was not within our control and with four exceptions the men themselves were not of our selection No transportation was allowed these in spectors and it was necessary to arrange ▮ best we could for the local Red Cross chapters or others to fur nish the necessary transportation

These inspectors were instructed to obtain from local physicians and plantation owners or mana ers informa tion as to possible malaria carriers that is those who had been actually sick with malaria during the 1926 season Right here we ran into complications With very few exceptions the information obtained from physicians was of no value and it was necessary to fall back upon information received from plantation owners and managers When they were told that it was the intention to screen the homes of malaria carriers then all of their tenants or share croppers had had malaria If we stated that it was the intention to take steps to prevent the spread of malaria without givin the method then malaria was an unknown disease and no one had it So many had been given typhoid vaccinations that as soon as malaria prevention was mentioned it imme diately brought to mind the hypodermic needle Be cause of these difficulties the work of locating and measuring homes of probable malaria carriers proceeded rather slowly during the early part of the work with a corresponding high cost Later when malaria cases be gan to appear the instructions were mod fied so as to allow for the measuring only of houses within which a probable case existed The work then peeded up

The data obtained was similar to that as described in Dr Coo le s paper except that we did not obtain the number in the family under 15 years of age We did however obtain and record the names ex and ages of the probable carriers In obtaining records carbons were u ed the original copy being forwarded to head quarters at Pine Bluff and the carbon copy retained by the in pector

Health Units involved to select the houses take the measurements and direct the application of the screens when they were delivered The arrangement left me with the main duty of developing the shop at Dyersburg Tennessee

The shop was operated under the direction of the manual training instructor of the Dyersburg School and twelve of his students and in the course of operation covering a period of two weeks during which 1440 doors were made the following changes in methods were made as compared with the operating schedule of Dr Coogle s factory

(1) After experimenting for some time it was found that all frame members of the doors including the two cross rails could be sawed prior to assembly provided the cross rails were sawed ⅛ inch shorter than the theoretically figured This saved considerable time and still gave excellent fits for the cross rails

(2) In the production program attention must be given to lessening the physical labor involved in the various operations and it occurred to the shop foreman that the laborious use of 6 foot cabinet maker's clamps for holding the door joints together while applying the wire screen could be avoided and a similar result obtained by inserting a /x5 corrugated nail (a nail made of sheet metal / inch long and containing five corrugations) across each corner joint prior to the application of the wire screen Cabinet makers clamps were not used at all in the Dyersburg shop the corrugated nails inserted on the first table after reversing and rewedging the partly assembled door holding perfectly

(3) The use of wedges driven between the screen clamp and the door to move the door away from the clamp and thereby stretch the wire screen was somewhat slow and not altogether satisfactory and the shop foreman devised a much faster method of doing the same thing This consisted of four wooden fingers projecting through and working in slots in the table top between the clamp and door end and hinged below these fingers being actuated by a foot pedal working in a notched rack at the table end The stretching operation thereafter took but a step on the pedal and was very quickly done

(4) In addition to the padding on the screen clamp we studded the upper holding edge with fine wire brads to give a positive grip This feature worked to perfection and did not injure the wire screen in any visible manner

In view of the short time the Dyersburg shop operated that is 14 days and also in view of the fact that some of the above changes were not installed until the work was well under way it is unfair to attempt to show an increased production due to these changes. However in a test where the only incentive to the boys was that they were told the shop would close for the day after 125 doors were made we found that number finished at 2 P M by twelve boys I am confident that a daily average of 175 doors could be maintained by twelve boys or fourteen and half doors per boy per day if working on door assembly alone

The problems we encountered in transporting and applying the screen doors and window materials are essentially those found in the other projects and I will not burden you with these

The reaction to screening by the tenants, practically all of whom are white is promising Many of the tenants started to paper over with newspaper and paste the cracks and other openings left and many others have been induced to start this work Approximately 15 per cent of the homes screened have been rendered mosquito proof

The Health Officer of Lake County laments that he can not claim as many screened houses as he figured on in his County because he says "Five families moved out of the county carrying the screen doors with them" This is rather a new phase of public health work. I have not yet heard of a tenant s carrying his sanitary toilet with him when he moved to another location

The work this past summer was in the nature of an emergency much of the material and supplies were bought at emergency prices and when screen work is contemplated in the future emergency prices will not in all probability exist At present the manufacture of this door requires special equipment, the materials of which the door is made are too costly and the method of assembly is not suitable for the small farmer who may want to screen only a few homes.

I believe that woods much cheaper than cypress can be found which will be satisfactory There is evidence tending to show that 24 gauge sheet metal is heavier than necessary for strength and possibly 26 or even 28 gauge might serve as well With these lighter gauges the extra operation of punching nail holes could be avoided and possibly smaller nails used doing away with clinching and permitting handling with a magnetic hammer

These possibilities should be investigated. A type of door can be produced that is cheap in price effective in service and that a farmer can cut lay down on the floor and assemble for his own or tenant houses with practically no outlay for equipment

Mr J A LePrince U S P H S Memphis Tenn—When the U S Public Health Service was requested by the Red Cross to assist in giving protection against malaria transmission to the farming population of the flood area the question to decide was how to obtain maximum results at lowest cost in a very short period of time and how to plan the work so that it would have a future as well as a temporary value

It was realized that the project would be subject to delays beyond our control that we should have to deal with undetermined factors and unknown quantities We asked for only such limited funds as we could spend to sanitary advantage and we returned some of the funds allotted One of the questions we had to answer in May was, how many doors and windows were there on the thousands of farm tenant homes than deluged by the flood that it was proposed to screen? How much would it cost and how long would it take to have the houses screened? Which of the flood covered homes would be occupied by families containing malaria cases or carriers? Where were we to obtain transportation to do this work in thirty seven counties of four states, and to what extent would the lack of transportation delay the work and increase the costs? The problem was to do a years work in ninety days without knowing the conditions we were to work under nor the difficulties that were waiting to interfere with our progress.

In each of the four states where screening of homes has been accomplished the director of the work was given all the responsibilities that go with such an emergency task and it was left to him individually to determine the solution of such difficult problems as were continually cropping up We had a fixed date

material Notification that the material was ready for distribution was made in part by the in pector and in part by the local Red Cross It was requested that this material be obtained at the earliest possible moment It was found however that this material moved slowly and that when the work was being brought to a close a considerable amount of the screening material was still stored at the points of distribution However there was a waiting list in each county made up of planters who had become interested in the work and upon whose plantations few if any houses were included in the first survey These men supplied the information required and agreed to install such screening as might be assigned to them immediately Such material there fore as had not been called for was issued to these planters and our records changed accordingly

In the screening of the houses and the hanging of the doors it was expected that the greater part of the work would be done by the plantation owner or house occupant under the direction of and assisted by the inspector It was impossible for the inspector work ing alone and in only one county was any additional help given to complete the work within the time set In the greater part of the counties however the inspec tor did actually do a very considerable part of the screening and as a general rule it was with difficulty that he was able to obtain necessary assistance required from the planters Furthermore the manner in which the material was taken out made the work more dif ficult since it was impossible to take up each plantation in its logical order

As would be expected some of the inspectors were able to obtain more assistance or to accomplish more in the actual screening than others.

In Pulaski and Phillips County the installation of the screening was turned over in its entirety to the county health units and in three other counties assistance was rendered by the county units

The manner in which the work was carried on makes it impossible to attempt to state the average number of doors which it was possible for one man to hang or the number of houses which one man could properly screen in a day For the most part the inspectors reported 4 to 6 houses completed The number of course depending upon the assistance rendered The inspector working alone could average about four houses per day

Both the cloth netting and the screen wire were used in screening the windows Under the original plan the use of the cloth netting was compulsory Approximately 12 000 yards of this netting was used When this was exhausted however screen wire was used In all forty per cent of the windows were screened with screen wire this varying from 0 in some counties to 100 per cent in others Paper and paste for sealing cracks and also small wire baskets made of the screen wire holding naphthalene balls for chim ney protection were shipped to each county The naphthalene balls were shipped in ½ pound paper bags each bag holding the required amount for one basket

The sealing of the cracks was left to the house occu pant and it is not possible at this time to state to what extent this part of the work was completed except in three counties In Lincoln and Jefferson Counties the inspector required the house occupant to do this work while screening was going on In Lincoln County on the pain of not installing screens In these two counties the houses sealed will probably run between 75 and 90 per cent A report from Pulaski County gave 65 per cent as sealed

The cost of materials and labor for the construction of screen doors averaged $1 52 per door including all of the hardware and nails as well [illegible] lumber for door facings The average cost per house for complete screening including estimates for the amount expended in money or labor by the planters but exclusive of the supervision of the Public Health Service was $10 00 per house

The total number of houses screened was 2 348 requiring 7 304 doors or an average of 3 11 doors per house and the screening of 12 200 windows with an average of 5 2 windows per house It was noted that there was quite a difference in the number of doors and windows per house in the various counties the door average ranging from 2 4 to 3 52 and the aver age number of windows from 4 to 6 7

In the 2,348 houses a total of 4 572 probable malaria carriers were reported

The work was carried on in [illegible] counties covering 699 plantations large and small.

While at the start of the work there did not appear to be great amount of enthusiasm on the part of the planters considerable interest was aroused before it was completed and it is believed that there will be a considerable increase in screening in the future This possible increase will depend to considerable extent upon the care given the screening already installed The enthusiasm evinced by the occupants of the houses on the completion of the screening would lead one [illegible] believe that for the most part proper care will be taken The simplicity of construction as well as the strength and durability of the doors made a considerable im pression upon many of the planters In several instances plans were under way for more or less com plete screening of certain plantations using our type of door the planters stating that they had been sold [illegible] the screening

Each door hung had a small sticker or poster attached calling attention to the manner in which malaria is transmitted and showing how the house occu pant might help to stop the spread This small poster aroused considerable interest

The simplicity of the construction of the doors as well as the method of hanging makes it possible for a plantation owner to construct them with more or less unskilled labor and to screen the houses at low cost A hammer saw screw driver and tack hammer are all required in the way of tools Twenty four feet of one by six inch boards a few wooden wedges and a small piece of metal plate to clinch nails against would be all that would be required to make a frame arrangement and wire stretcher If material [illegible] bought at retail and labor costs are not included the average tenant house could be screened for [illegible] cost of [illegible]00 to $10 00

Mr H A Johnson U S P H S Memphis Tenn In this discussion I shall confine myself to the screen work as carried out in the overflowed sections of the West Tennessee Counties and particularly to that part of the work which represent a departure from the routine established by Dr Coogle and which we have all more or less followed

It was very late in July when the program for screening same 450 homes in the West Tennessee area was finally approved and in view of the necessity of pushing the work to a conclusion before the relatively short period of summer in that locality should come to an end the State Health Officer of Tennessee tem porarily placed extra men with each of the County

by me in LeFlore County Mississippi When my report of the costs and results of the screening of these 20 houses was read by Dr Fricks it was so different from the opinion of many Mississippi planters who had previously expressed themselves as thinking it was not feasible to screen poorly constructed tenant houses that Dr Fricks insisted that the experiment be repeated during the year 1925 Twenty additional tenant houses were screened during that season with similar results and with a lower cost in construction

By that time Dr Fricks felt that the calculations made by Mr LePrince and me as to cost of screening poorly constructed and dilapidated tenant houses was within economical reach of property owners and gave sufficient protection to the tenants to justify its use as an anti malaria measure In 1926 he decided that he would have me screen a plantation of 64 houses which I did The results of this experiment were very similar to the two previous ones When this recent emergency arose Dr Williams and Mr LePrince were in a position to offer a practical anti malaria measure by the use of screens and also to give the approximate costs

It is indeed gratifying to me to have proven by Mr Tarbett Mr Fletcher and Mr Johnson in their work in Arkansas Louisiana and Tennessee respectively that the calculations that we made on the small group were so accurate and feasible that they were applicable whether we be screening 20 tenant houses or 6000 tenant houses and whether we be making 50 screen doors or 20000 screen doors

It is convincing that screening tenant houses is a practical and common sense thing for people to do and it can be done in Arkansas Louisiana and Tennessee as well as in Mississippi with practically the same effectiveness and costs

There are two matters I should like to take up which I did not take up in the paper Screening of course is placing a barrier in order to reduce the number of mosquitoes that may get into the house and thereby to reduce the number of mosquito bites that the inhabitants may be subjected to

There is another route by which mosquitoes enter houses and that is by way of the chimneys This is a proven fact and for a long time it was thought that the proper method of closing this entrance was to screen the tops of the chimneys If screening the tops of the chimneys is properly done it will prohibit the entrance of mosquitoes but when it was found that it was more expensive to screen a chimney than to build a screen door for a house thought was given to other means of coping with the chimney problem and from experiments conducted by me in LeFlore County it was found that naphtha a mosquito repellent could be hung in the chimney This proved to be more practical than to screen the top of the chimney It does not block the chimney nor prohibit the use of the fire place during the summer months

This device is a small wire screen basket $2\frac{1}{4}$ inches in diameter and 12 inches high with a 1 inch core through the center to allow for ventilation The baskets can be made for less than 10 cents each Naphtha with which to fill them costs about 10 or 12 cents a pound Therefore these baskets can be made and filled for less than the price of wire screen the size necessary to cover the top of a chimney

In constructing this device ordinary wire screen 16 mesh is used for the body the bottom and the ventilating column although any perforated material may be used To form the body a substantially rectangular piece of wire screen 12x9 inches is rolled into cylindrical form One longitudinal edge of this rectangular piece of wire mesh is bent inwardly upon itself and the opposite longitudinal edge is bent outwardly upon itself to form flanges which interlock and when clinched serve to hold securely the body in cylindrical form The ventilating column is formed by clinching in the same manner as the body a strip of wire screen 12 by 3 inches

A circular piece of wire screen slightly larger in diameter than the diameter of the body is cut to form the bottom Onto this bottom is affixed the ventilating column by intertwining or interlacing the lower ends of the vertical strands of wire of the ventilating column with the mesh of the bottom This bottom with the ventilating column attached is then affixed to the edge of the walls of the body by intertwining or interlacing the vertical strands of wire of the body into and with the mesh of the bottom

When this bottom is affixed the ventilating column will be positioned within the body in a substantially vertical position and extend from the bottom to which it is attached upwardly approximately the whole height of the body and into the cone top forming an annular chamber around the ventilating column

Into this annular chamber is placed 1 pound of naphtha balls a substance disagreeable to the mosquito An imperforate conical top the lower edge of which is of substantially the same diameter as the diameter of the body is fitted into the open top end of the body This conical top is held into place by crimping the upper edge of the body A wire is affixed to the top of the conical top for suspending the basket of naphtha balls three feet from the top of the chimney This allows a free passage of smoke through the chimney in case the occupants of the house desire to have a fire during the summer months In most cases where there are grates or fire places the occupants build fires in them on rainy days and ironing days

The other matter I should like to mention is the "LePrince patch" for patching holes that may be punched in the screens by children or careless adults This patch is made by cutting a square piece of wire screen pulling the threads for about ½ inch from the four edges With an ordinary knife to act as a vice these four edges are bent at right angles in the same direction and a patch is placed over the hole in the window or door and the ends of the wire are bent holding the patch in its proper position It makes a very neat and effective patch and can be done by any child of ordinary intelligence In addition to closing the opening in the screen it creates an interest in caring for screens thus reducing the maintenance problem

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MALARIA IN PALESTINE*

By PAUL S CARLEY M D †
Belzoni Miss

From May 1922 until June 1925 I was assigned to the Government of Palestine to assist

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty First Annual Meeting Memphis Tennessee November 14-17, 1927

†Field Director International Health Division Rockefeller Foundation

for the completion of the work and everything was of secondary consideration except cost and speed

During the limited period of field operations varying from 42 days in one state to 120 days in another more than 6700 homes of malaria cases in the flood area were screened And if we had been permitted to sell screen doors to all who tried to buy them at the temporary screen door plants this number would have increased considerably

At the four screen door plants more than 21 000 screen doors were made and shipped out and we all learned much that we did not know before about screen door construction What will interest you most is that while everything else may go up the cost of screening farm tenant homes of malaria carriers is going to go decidedly down and that there has been developed by the flood a decided upward tendency for screening of farm tenant homes One negro mammy even claimed that the highest power of all would surely bring the world to an end cause white folks is screening colored pussons homes

Of course we all realize that although more than thirteen million dollars worth of wire screen is made by the manufacturers annually yet in malarious districts the families that screening would help most are the very ones that have least of it It will be of big sanitary advantage to the entire rural public of malarious districts to have the homes of the families having malaria cases kept effectively screened and all honor to the few pioneer county health officers that are now busy creating this condition

The outlook appears so rosy that some of you may decide there is a catch in it and *you are correct The* speed of progress will depend entirely upon the care given to the screen by the farm tenants Dr Coogle County Health Officer of Leflore County *Mississippi* has proven that even with constantly changing colored farm tenants a county health officer can induce those tenants to take better care of the *screening on their* homes than is given to the screen on homes of the average white family

The old objection is that a large number of malaria carrier homes are too loosely built to screen effectively *In answer to that it can be stated* that within the last ninety days in two counties of Tennessee 15 per cent of the tenants whose homes were screened voluntarily covered up the wall cracks through which mosquitoes could enter Also the County Health Officer of Pulaski County Arkansas who is really interested in the health status of his county induced 65 per cent of tenants of poorly built homes to paper the walls where mosquitoes can enter

We are not satisfied yet with the type of screen door we are making It is stronger cheaper and will last longer than any other type yet made but we believe if its cost is materially reduced more homes of malaria carriers will be screened and screen door manufacturers will be induced to enter the field with a more substantial door at a lower first cost and a lower annual cost

In making the doors for the flood area homes speed of construction was an important factor This factor can be omitted under normal conditions We may be able to construct a new and even stronger door at less cost without using clinching nails and without using a framing table A door that can be framed on a barn floor or porch floor at a lower cost than we are now making them and which will last longer in actual use is our objective and we shall probably have it within a year from now

One enterprising county health officer had screen doors made at the county agricultural fair to show farmers how to do it Another was not even satisfied with such a continuous demonstration at a state agricultural fair but is arranging to screen the homes of all farm tenant malaria case families of his county The work is now being done and he already has screen doors made for 112 houses One of our prominent state health officers is planning to screen all malaria carrier homes of an entire county

What is going to be the result of all this activity?

As the sales of screen have advanced in recent years, the malaria prevalence has lowered itself

There is a strong tendency today for manufacturing plants to get away from large centers of congested population and as malaria prevalence is lowered labor turnover is likewise decreased and labor efficiency increased so the day may not be far distant when we can and shall look back at the Mississippi River and be thankful for the flood it brought us and the substantial benefits that followed the flood period Whether or not this condition of malaria elimination will come rapidly depends altogether upon the effort the full time county health officers put into this quick and economic means of banishing malaria

Dr W J Sandidge Shreveport La—Our inspector assisted Mr J A LePrince and Mr A H Fletcher to screen about 650 tenant houses for the American Red Cross in the Monroe area We then visited about twenty five prominent planters of Caddo Parish asking them to pay for screening a few houses on their plantations as a demonstration Of this number twenty one agreed to have the work done We used Mr Fletcher's figures and Dr Coogle's bulletin on screening in explaining just how the work would be done They didn't believe it could be done so cheaply but we succeeded in convincing them We had our own truck so could transport materials to their plantations and let them furnish some labor to help with our inspector in screening houses Thus the net cost to the planters would be only for the materials and tenant labor a total of about $10.00 As a matter of fact we shall come below the $10.00 cost because the tenant labor is furnished by the planters free

Screening the carriers will be our first objective However we wish to go further Several planters have already said they wanted more screening done

During the seven days of the Louisiana State Fair we had for a demonstration the building of these screen doors Our labor cost was nothing as we secured the help of the boys from the Manual Training Department of the Shreveport Colored High School

Dr Felix J Underwood Jackson Miss—It is largely because Dr Coogle was willing to pay attention to the little things that he was able to make a success of this work

Dr A T McCormack Louisville Ky—We have made investigations in two localities in Kentucky where we had an epidemic of poliomyelitis, evidently fly borne In properly screened houses there was not a single case of poliomyelitis while in the unscreened houses there were [illegible] children who were infected in a distinctly fly born epidemic All the cases occurred in unscreened houses.

Dr Coogle (closing)—In 1924 when the subject of screening was discussed by Dr Fricks and Mr Le Prince a series of 20 houses was selected and screened

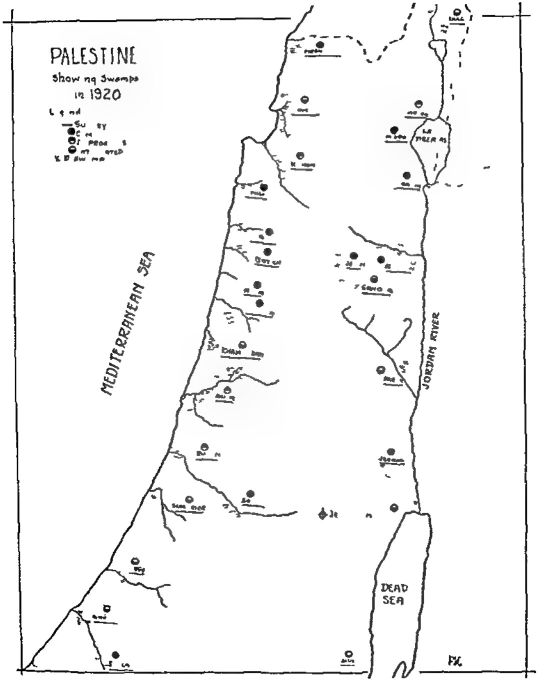
PALESTINE
Showing Swamps
in 1920
MEDITERRANEAN SEA
JORDAN RIVER
DEAD SEA
P.K.

Chart 1

in malaria survey and control operations Of the observations recorded in this paper, some are personal and many were made by my colleagues, both in Government service or attached to the Government by outside agencies

Some knowledge of the geography and topography of Palestine is necessary before a clear picture of the malaria situation there, can be drawn Palestine and Syria north of it form the northern end of the Arabian Peninsula Two *mountain ranges the Lebanon and Anti Lebanon* running parallel to the Mediterranean, with a deep valley between them and a flat and almost unbroken plain lying seaward of the eastern or Lebanon Range shut off this corner of the Arabian Plateau from the rest of the peninsula The proximity of the Mediterranean Sea and *the topographical interruption by the mountain* ranges make this corner of the Arabian Plateau the most fertile and least arid of all Arabia

Modern Palestine is a small country its greatest length is about 135 miles and its maximum width 65 miles It is bounded on the west by the Mediterranean Sea on the north by an empirical *line on the east* with minor exceptions by the Jordan River and on the south by a line through the Negeb or South Desert

It is further divided naturally into three distinct geographical sections The Coastal Plain the Mountains of Judea and the Jordan Valley The most westerly division the Coastal Plain is a *flat sandy* or sandy loam area lying along the sea coast at an elevation not exceeding 300 feet above sea level The mountains of Judea (the Lebanon Range) jut out to the sea at Mt Carmel and break an otherwise continuous strip of flat land across the entire western side of the country varying from 5 25 miles in width

The mountains or central range likewise parallel the sea and run the length of the country *except for one break in their continuity at* the plain of Esdralon They rise gradually to a height of 3000 3500 feet above the Mediterranean The central range has a maximum width of 25 miles and is flanked by foothills in the west *and by the Jordan Valley* on the east

The third geographical division of the country is the Jordan Valley, a north and south rift in the earth s crust dropped from the highlands on either side This valley is the division between the Lebanon and Anti Lebanon Ranges From Mt Hermon at the north to the south end of the *Dead Sea through* Lake *Hule* and the sea of Galilee its length is not over 150 miles The Jordan River a small and rapidly flowing stream, cuts the valley below Lake Hule in two almost even parts, except where it flares to form the sea of Galilee From the south end of Lake Hule to the southern limits of modern Palestine the valley lies entirely below Mediterranean Sea level, and the lowest part, the Dead Sea surface, is 1292 feet below the Mediterranean

Watershed—Almost all of Palestine drains toward the sea, and only a small part drains eastward, toward the Jordan

Climate—The outstanding feature of the climate is its defined rainy season from November until the last of March The rainfall varies in the different geographical divisions from 32 inches annually on the Coastal Plain to 6 in inches in the Jordan Valley

Watercourses—*Along the Coastal Plain* spaced at almost equal intervals are twelve small streams These rise with few exceptions in mountains and foothills and run in a westerly to northwesterly direction to the sea They are alike in that their current except during heavy rains is slow their mouths are blocked or partially *blocked at the sea by* sand and they dry up in their upper reaches in summer leaving pools along their courses Near the sea they form marshes sometimes of considerable extent In the mountains are no large streams The Jordan River receives below Lake Hule only two important tributaries the Jalud River and the Wadi Farah, but there are other short water courses which empty into it

Water Table—In the Coastal Plain the water table lies near the surface and shallow wells are numerous In the hills except for an occasional spring there is no fresh water, except that stored in cisterns In the Jordan Valley the water *table* lies deeper than in the Coastal Plain and water is obtained from deep wells or springs on the hillsides above the valley

The population in 1925 was 700 000 not including about 100 000 Nomads There is no definitely rural population except the Nomads The fixed population live in cities towns and villages The chief industry is farming

Malaria—The introduction of malaria into Palestine is obscured in antiquity There are no references in either the Bible or Talmud which can be definitely construed as referring to it There is some evidence that in the last century before Christ the Roman soldiery in Egypt suffered from the disease It is at least a tenable hypothesis that malaria entered Palestine via the Roman troops in the century before the

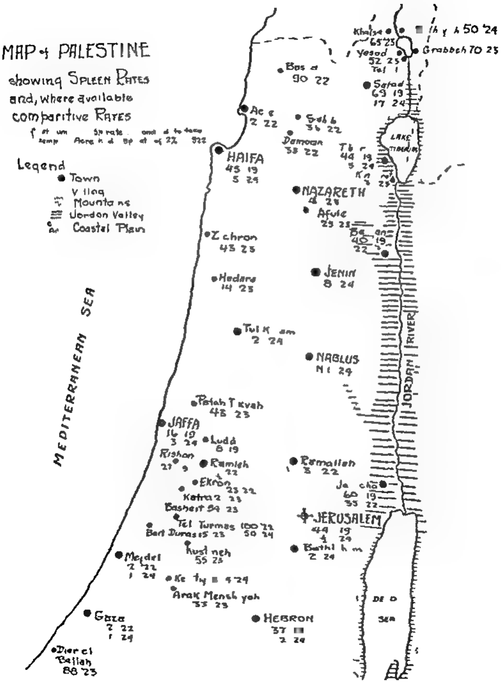
MAP of PALESTINE
showing SPLEEN RATES
and, where available
comparitive RATES
Legend
Town
Mountains
Jordan Valley
Coastal Plain
MEDITERRANEAN SEA
JORDAN RIVER
LAKE TIBERIAS
HAIFA
45 19
5 24
Grabbeh 70 25
Yesod
52 25
Safad
69 19
17 24
Damoan
33 22
Bas
90 22
NAZARETH
Afule
23 23
Zichron
43 25
Hedera
14 25
JENIN
8 24
NABLUS
JAFFA
16 19
3 24
Ludd
8 19
Rishon
Ramleh
Ekron
Katra
Bashert 54 23
Tel Turmus 100 22
50 24
Beit Duras 65 23
Ramallah
JERUSALEM
44 19
4 24
Majdel
Arak Menshiyeh
33 23
Gaza
HEBRON
Dier el Bellah
88 23
DEAD SEA

Chart 2

birth of Christ * In 732 A D, Heraclius in defending Beisan in the north Palestine cut the canal system around the town to impede the progress of the newly conceived forces of Islam, and swamped the surrounding territory It is possible that this date marks the beginning of malaria in the North Jordan Valley † Certainly the Crusaders suffered from the disease and in 1799 Napoleon s troops at the siege of Acre, on the sea coast were ravaged by it

Except for the work of Muhlens Yofe and a few others we have no definite records of malaria until the British occupation of Palestine in 1917 Muhlens showed that about 23 per cent of the residents of Jerusalem had parasites in their blood in 1913 Toward the latter part of the Great War the Turkish Army suffered severely with malaria as evidenced by prisoners of war [1]

G Stuart[2] reviewed the statistics for 1922 24 and shows that of 90 872 blood films examined 13 711 or 15 per cent were positive for malaria Further in separating the positive films he found 69 2 per cent benign tertian 29 3 per cent subtertian and 1 5 per cent quartan He also showed that benign tertian was most prevalent during June, July and August subtertian was most common during October November and December No conclusions were drawn on the occurrence of quartan malaria

Anopheles—Buxton [3] preceded by Barraud and Lowe and with some assistance by the writer and Mr J J Mieldazis worked out in 1922 and 1923 the anopheline fauna of Palestine

Nine species of anopheles have been reported in Palestine and of these six were commonly found and four were important The other three were rare and from our standpoint negligible

The most important vector was *A bifurcatus* a cistern and well breeder Muhlens recorded it as the only species found in Jerusalem in 1913

A elutus (*maculipennis var elutus Edw*) was a widespread marsh and swamp breeder confined almost entirely to the lowlands

A superpictus and *A sergenti* similarly low land species, were fairly widespread and bred in water in which there was some motion

A hyrcanus (*sinensis var pseudopictus Grassi*) and *A algeriensis* were marsh breeders and definitely rural in their habits did not enter houses and were unimportant as vectors Of the other three *A multicolor* was a salt water breeder found in some parts of the lower Jordan Valley and along the seacoast, and of little importance The remaining two *A pharoensis* though very common in Egypt was very rare in Palestine, and a single specimen only of the remaining one, *A mauritianus*, was taken by Barraud

Surveys and Control—From the establishment of Civil Administration in 1919, the Government activities in malaria may be summed up as follows

(1) Preliminary surveys of sources of malaria by officers of the Department of Health

(2) The formation of an anti malaria advisory committee

(3) Entomological survey already mentioned by Buxton

(4) The promulgation of an anti malaria ordinance for enforcement of control measures

(5) Organization of cities and towns for control of breeding mosquitoes

(6) A village organization for oiling and other anti mosquito measures

(7) The addition of two units to assist the Government in anti malarial work first

A Malaria Survey Section consisting of a physician (the writer) a sanitary engineer and for part of the period the Government entomologist in May 1922 and second the Malaria Research Unit consisting of a director an assistant a sanitary engineer and a laboratory director together with a corps of assistants (inspectors and oilers in October 1922) The Survey Section assisted the Government in delimiting the malaria problems among the non Jewish population where the Research Unit dealt with the Jewish population and nearby Arabs

In the period 1922 25 the two units surveyed most of Palestine examined villagers and nomads for blood infestation and splenomegaly proposed control measures and assisted in carrying these out In certain areas detailed schemes were drawn up in others general recommendations were made

Early after the establishment of the civil administration it was realized that malaria was

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*Jones in the Archives of the Liverpool Univ ity 19 1 has given a very chola ly summa y of the various r fe enc s con erning f vers in the Roman Empire under the heading Dea Febris

†Dr Clarence Fisher of the Univ ity of Pennsylvania was conducting field ope ati ns in arch eological research in Bei an dur ng the summer of 19 On numerous occa i ns he di cus ed with m the absence of any record of fevers that might be att ibuted to malaria up to th time f the Islamic Inva ion He was rather firm in his opinion that Bei an wa malaria f e until the demolition of the irrigation system noted above

detail, but the general plan was the same In cases where the expenditure of Government funds seemed justifiable Government money was used In general the policy of the Department of Health in the control of the disease was toward anti larval work Under existing conditions the measures suggested in and near the swamp areas narrowed down to drainage and irrigation regulations The important schemes which have thus far been carried out or are in the process of being carried out are

(1) Beisan Drainage by Government and local funds of a swamp of 3200 acres west of the town Following this work the blood infestation rate dropped from 12 5 in 1922 to 1 7 in 1924

(2) Jericho Reorganization of the irrigation system at a cost of $2000 so as to prevent mosquito breeding in irrigated gardens This scheme saved sufficient water for irrigation of 100 extra acres paid for by Government funds

(3) Wade Rubin At the present time work is under way for drainage of a 1250 acre swamp along the course of this river This scheme is being financed by the Supreme Moslem Council

(4) Numerous drainage and irrigation works are done in Jewish colonies on funds of the Malaria Research Unit

In addition plans are on hand at the Department of Health in Jerusalem for

(1) Hule Basin reclamation a large scheme involving the drainage of Lake Hule the reclamation of its bed and the reorganization of an immense irrigation system in an area of over 100 square miles

(2) Kishon Marsh reclamation a scheme involving the reclamation of about twenty square miles of land near Haifa

(3) Namin River area

(4) Smaller operations

These are to be carried out as rapidly as possible The total sums pent on Anti Malaria work in 1924 averaged 20 cents per capita for 700 000 population

Results —Swellergrebel[6] in summing up the results as seen in a tour of investigation by the League of Nations Malaria Commi sion in 1925 brought out the following points

(1) Malaria in the two or three years previous had been less prevalent and less severe than in the past The decline (especially in towns) is due to meaures taken against the disease

(2) Much of the success was due to the enlistment of assistance from the people of the country and the development of a general public health service

No accurate comparison of the present conditions with regard to malaria and those of the pre-war period can be made A map showing the decrease in spleen rates throughout the country from 1919 1925 is shown (page 751) Certainly the efficacy of anti larval measures is strikingly shown in some of the mountain towns and in Bei an and Haifa in the lowlands

When the remaining larger schemes have been put into effect the continuous effort along standard lines of control in force for a greater period of time and when the general betterment of the population attendant on other practical public health measures now being worked out in the country has had an opportunity to become more evident it is reasonable to believe that malaria may become at some not too distant time a very minor public health problem in Palestine

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7 The geographical ef la g ly tak n f om Smith G Ad m The Hi t ical Geogr phy of the H ly Land nd ed Hodder & Sto ght n Ltd. L ndon, a d f m p rso al b rvati

DISCUSSION—(*Abstract*)

Dr T H D Griffitts Biloxi Miss —Dr Carley said that *A b fu catus* breeding in artificial containers was responsible for a great deal of malaria but I do not believe he mentioned the mosquito that was responsible for malaria in the coastal pl in in the salt marsh areas Will he enlighten us on this point?

Mr J A LePrince Sanita y En ineer U.S.P.H.S Memph s Tenn —With regard to the containers and mosquito breeding in the containers did they have any difficulties in the use of fish as a means of control?

Dr Ca ley (clos ng) —*Gamb a affinis* is not found in A ia Minor but there is an indigenous fish a pecies of cyprinadon similar in size to gambusia that is widely distributed in the natural waters of Palestine feeds at all levels and will under certain ci cumstances completely control mosquito breeding We used it with success in open agricultural wells and some cisterns The word cistern" refers in Palestine to a much larger structure than we associate with the term here There a cistern is built to hold relatively enormous quantities of water is ordinarily almost compl tely closed and is so constructed that little if any sunlight enters it. Cyprinadon will not live under the ordin ry cond tions obtaining in such a structure Its use was limited to

widespread throughout most of the country. It was equally realized that in the mountainous section the great potential sources of production of mosquitoes were the village and town cisterns. As has been pointed out before, the only source of water in this area was stored rain water. As it was known that *A. bifurcatus* bred in cisterns and that *A. bifurcatus* was the only anopheles present, vigorous measures were instituted for the eradication of this mosquito. The result was one of the classical examples of anti-larval operations in malaria control. A corps was organized to oil cisterns and wells and assist the property owners in installing mosquito-proof cisterns and wells. The larger towns had a gang of men working full time in the town. The smaller towns and villages were served by a traveling inspector who visited each village once every two weeks. Some idea of the size of the task may be gained when, in Jerusalem Town, there were over 5000 cisterns to be oiled every fortnight. In 1924, for the entire country, there were 49,600 potential breeding places on record and a total of 1,090,911 inspections were made. 516,686 "oilings" were carried out in this year.[4] The results are well illustrated in the case of Jerusalem town, where Muhlens reported a 23 per cent blood infestation in 1913 and the spleen rate among school children was 44.5 per cent in 1919 and where in 1924 the blood rate was 0 and the spleen rate 0.5 per cent. Another example is Hebron, where the spleen rate was 37 per cent in 1919 and 2 per cent in 1924. This work was well organized in 1922 when the two units just mentioned were added.

The control of bifurcatus breeding did not, however, solve the entire problem, for the malaria on the Coastal Plain, the plain of Esdralon and the Jordan Valley presented an entirely different aspect, interwoven with the study of *A. elutus*, *A. superpictus* and *A. sergenti*. Reference to *Chart 2* gives some idea of the extent of marsh land in the country. Cantor[5] estimated the area of land which had been surveyed by the Government and the two Malaria Units, and on which work had been carried out or was anticipated, at 70,027 acres. Unfortunately the rich land in the country lies in or near these marshes.

The questions involved in dealing with these areas were, first, a determination of the role played by these swamps in the malaria problems nearby, and second, whether or not a feasible economic plan might be drawn up to deal with the situation. As a general rule all the water in the country was needed for irrigation, as irrigation is very necessary in Palestine for successful farming. At the outset it was realized that the dominant characteristic of any drainage scheme must be the conservation of water so that the irrigated land area might be increased, but by an intelligent application of the principles of irrigation to minimize or eradicate anopheline breeding.

With that point in view and the town anti-larval work on *A. bifurcatus* well organized, practically all the swamp lands in the country were studied by the two units. Some preliminary work had been done previously by the officers of the Department of Health in certain swampy areas. Five large swamps in the north of Palestine were studied, Beisan, Kisbon, Namein, Sanour and Hule, in the first year and a half. At Beisan some drainage work had already been done. The area was mapped, the population examined and a further scheme, consisting of drainage and irrigation regulation, was drawn up. Following the Beisan work, reconnaissance surveys were made at Haifa on the Kishon Swamp, at Acre on the Namein Swamp, at Hule on the swamps near the lake and at Sanour. In 1923, in the spring, the Coastal Plain towns in the south of Palestine were studied. It was determined that in this area the malaria problem was not of sufficient importance to necessitate any measures further than the routine *A. bifurcatus* control already in force.

Next the anti-malarial work in Haifa town was reorganized and the Kishon Swamp mapped and a drainage scheme worked out. Jericho Town and surrounding country were next studied and here a simple scheme of irrigation regulation was drawn up. The Hule Basin claimed attention next and this area was studied rather completely and a large engineering scheme was suggested as the only means of control feasible there. Later the swamp at Wadi Rubin and the north coast of the Dead Sea were examined and control measures outlined in these places.

Control Measures.—As rapidly as they were drawn up, special control schemes were presented the Anti-Malaria Advisory Committee in Jerusalem. This Committee, appointed by the High Commissioner, was composed of representative men of each of the three religions of the country and certain members from the Department of Health. This Committee discussed the control projects and was helpful in getting appropriations locally in places where the schemes were to be carried out. The details of the control schemes that were gotten up are too voluminous to review here. They varied in size and

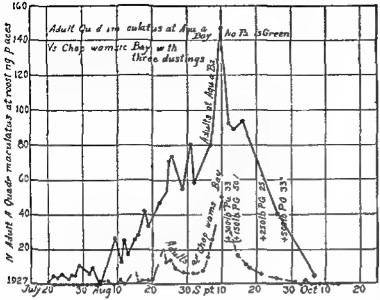

Chart 1

tried with very low wind velocities and were entirely successful In calm weather 50 per cent Paris green is too great Two experiences demonstrated this . These were test flights at the lower end of Aquia Bay On the first the plane flew about 50 feet above the surface of the water the day being practically calm After the flight most of the Paris green could be seen as a heavy green path approximately 150 yards wide A few days later the same experiment was repeated near the same place under apparently identical weather conditions The plane was flown at a very much higher altitude in order to increase the length of time required for the dust to reach the water thus securing a wide distribution of the concentrated dust On this flight the plane flew approximately 400 feet above the surface Although there was a dead calm at the surface of the water, there was evidently a fair breeze at the altitude of the plane because the dust was caught long before reaching the water and blown entirely away from the breeding area and disappeared in the wooded hills to the north of the Bay On the whole, 33 per cent Paris green in soapstone was found to be the most nearly satisfactory dilution for all conditions This dilution is sufficiently great to give excellent distribution in an almost dead calm by flying 150 to 200 feet above the surface The same dilution gave equally good distribution in 10 and 12 mile breezes by flying 25 to 40 feet above the surface of the water

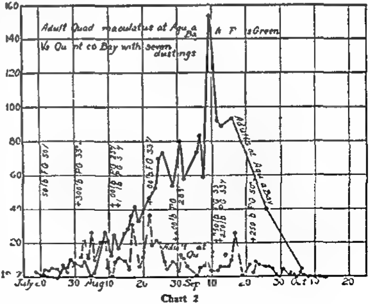

Chart 2

AMOUNT PER ACRE

During 1926 we had concluded[3] that one pound of Paris green per acre was the basic practical unit We have had no cause to change this opinion Three times during the season we reduced this amount and each time found it essential to redust either all or portions of the area of the Bay On August 11 with about 200 acres of active breeding in Quantico Bay we

the few cisterns that were more open and to agricultural wells and pond with clean edges

I stated that *A elutus* a species of anopheles very similar to the California *A maculipennis* together with *A superpictus* and *A sergenti* were responsible for malaria on the plains *A bifurcatus* played some part especially in urban malaria but the definitely rural malaria was transmitted in most cases by one or more of these three *A multicolor* the local salt water breeder bred in water in which the salt concentration was as high as 5 per cent It was a weak mosquito relatively speaking was limited in its breeding area to the seacoast and some parts of the lower Jordan Valley and so far as we were able to determine played no part in the transmission of the disease

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AIRPLANES AND PARIS GREEN IN CONTROL OF ANOPHELES PRODUCTION*

By S S Cook M D †
Quantico Va
and
L L Williams Jr M D ‡
Richmond Va

Six years ago Barber and Hayne[1] devised successfully tested and advocated the use of Paris green as an anopheles larvicide Since then this dust has been used in the control of the production of anopheles in anti malaria campaigns throughout the world The economy of Paris green rests upon two factors first its high toxicity and second, its ease of application

If carefully applied in high dilution, as done by hand as little as a quarter of a pound of Paris green may be sufficient to control the production of anopheles within an acre of breeding surface Such extreme care in application is not economical from a labor point of view and so for practical purposes from one half to one pound are usually applied per acre For this purpose the dust is usually mixed with some inert dust in the proportion of 1 per cent Paris green to total dust

Advantage is taken of the wind in distributing this larvicide Dust is released on the windward side of the breeding ground and the clouds float gently over the area to be treated depositing small quantities of Paris green for a long distance Distribution has been by hand by dust gun and by airplane The present paper has to deal with the latter method of distribution

In a former communication[3] the authors have gone into the history of this method of application and described the general technic of distribution giving their experiences in actual control work by means of airplane at Quantico, Virginia during the summer of 1926 Briefly summarized, the conclusions were that where production from large areas was to be controlled, airplane distribution of Paris green was easy, effective and economical

In the season just passed control work at Quantico was continued and further experiments were carried out along four general lines namely dilution of the dust, quantity of Paris green per acre, number of applications per season and ability to treat areas covered by dense vegetation

As can be seen from the following charts, the control of production of *Anopheles quadrimaculatus* was entirely successful at Quantico this year At every favorable roosting place near Quantico Bay and near Chopawamsic Bay the number of adults was relatively small at all times during the season At no time were adult anopheles prevalent in the camp At similar places near Aquia Bay where no control measures were practiced the numbers soon became large and remained so until cool weather set in

Chart 1 shows adult *Anopheles quadrimaculatus* at Aquia and Chopawamsic Bays

Chart 2 shows adult *Anopheles quadrimaculatus* at Aquia and Quantico Bays

DILUTION OF DUST

In considering the proper dilution of the dust it must be remembered that although 1 per cent of Paris green in inert dust is entirely successful for hand or dust gun application that this is too great a dilution to deliver from an airplane 100 to 150 feet above the surface We have heard of one attempt to control anopheles production by using a 1 per cent Paris green mixture[4] from airplane where practically no killing resulted The method was discredited in that area As we showed last year, 14 per cent Paris green is too *great a dilution to be successful under all conditions* with airplane distribution

During the past season we used 25 28 33 and 50 per cent (by weight) Paris green in powdered soapstone The lower percentages were

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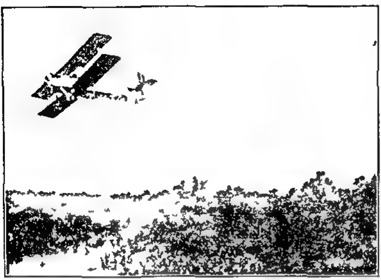
*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty First Annual Meeting Memphis Tennessee November 14 17 1927

†Lieutenant Commander Medical Corps U S Navy
‡Surgeon U S Public Health Service



TW 3 Dusti g ver mod ate vegetati n

Prior to this flight the inspectors dipped across the breeding ground finding larvae regularly at least one per dip The plane flew at right angles to the line of dipping (about 50 feet above the water s surface) delivering 150 pounds of Paris green in a 50 per cent mixture with soapstone Four hours after the flight dippings were made again at the same place Absence of live larvae and presence of a number of dead ones were found for a distance of 220 yards The plane continued its flight until all of the Paris green was gone traveling a distance of approximately two miles before delivering the last of the dust A lethal path 220 yards wide and 2 miles long is almost exactly 160 acres This checks very closely with last year s estimate of one pound of Paris green to the acre

NUMBER OF DUSTINGS PER SEASON

Whereas the summer of 1926 required four applications of Paris green to control production in Chopawamsic Bay during the past season only three applications were found essential This was due to the fact that breeding commenced in 1926 about the middle of July this year it did not commence until about the middle of August However during August very small areas in the Bay did breed so heavily that it was necessary either to apply Paris green or go out in a boat and oil As the areas were small they were oiled from a boat instead of being dusted

The breeding instead of being late in Quantico Bay, as was expected this year was almost two weeks earlier Very careful dippings were made frequently in order that we need not apply dust until the last possible day on which it seemed dusting would be effective This was done in an effort to increase the interval between applications In spite of this Quantico Bay required seven dustings during the summer of 1927 the same number it had required during the summer of 1926 Although weather conditions and breeding conditions had varied greatly at these two bays during these two seasons the number of dust applications and the time intervals were practically the same during the two years

The difference in cost per acre between the two seasons was less than 3 per cent the amounts of larvicide used varied less than 5 per cent the number of dustings varied not at all

TIME INTERVALS—QUANTICO BAY

19 6	19 7
1[illegible] days	10 days
[illegible] days	9 days
6 days	11 days
7 days	6 days
8 days	[illegible] days
7 days	9 days

These are certainly comparable intervals The average interval each year was eight days In spite of widely varying weather conditions the same number of dustings were required each year indicating that either seven migratory flights occurred each year from outside areas or that there were seven broods per season Effective control of an isolated breeding area may require an even le s number of larvicide applications

DUST PENETRATION THROUGH VEGETATION

The question has been raised as to whether Paris green penetrates dense vegetation and reaches the surface of the water in lethal doses As was pointed out in a former communication[3] when applied from a plane flying over Chopawamsic Swamp the dust did penetrate excessively dense vegetation with entire uccess On one occasion this was done successfully immediately

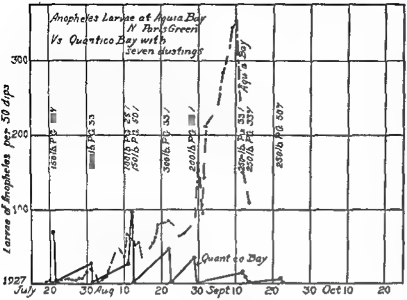


Chart 3

used only 100 pounds of Paris green in 25 per cent dilution. Larvae were approximately 25 in 50 dips on that day and the next day considerable portions showed as many as 100 larvae in 50 dips. An additional 150 pounds of Paris green was distributed in 50 per cent dilution which was entirely successful in killing all the larvae remaining in the Bay. On September 12 Quantico Bay showed 17 larvae in 50 dips and was dusted with 250 pounds of 33 per cent Paris green mixture. There were approximately 300 acres of breeding surface. The next day only a slight reduction in larvae was found over a considerable portion of the area whereupon another 250 pounds of 33 per cent mixture were applied. A few hours later larvae had disappeared entirely from the whole area. At the time of this experiment a similar experiment was tried in Chopawamsic Bay. Before dusting 32 larvae were taken in 50 dips over a breeding area of approximately 500 acres. Three hundred pounds of Paris green in 33 per cent dilution was applied, and three days later certain sections showed a marked increase in larvae, 100 being taken in 50 dips. It was necessary to re-dust these areas with 150 pounds of Paris green in 50 per cent dilution. This was successful in reducing the number of larvae to zero.

Chart 3 gives the effect of Paris green on larvae in Chopawamsic Bay. Larvae in untreated Aquia Bay for comparison.

Chart 4 gives the effect of Paris green on larvae in Quantico Bay.

Observations of breeding at Aquia Creek (near Quantico, Virginia) were made throughout the season in order that certain points might be determined by direct experimental work. Unfortunately, the breeding was very spotty over this Bay until August 23, when for a brief period larvae were found in high concentration throughout the entire area. Before floatage was destroyed by a heavy storm we had opportunity to make but one experimental flight, which revealed information as to the amount per acre and the width of the path which could be expected on a calm day.

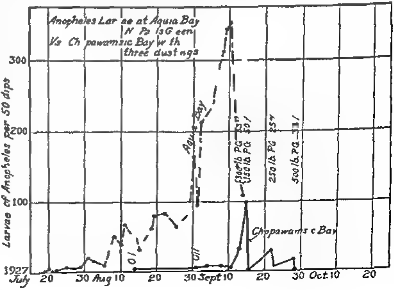
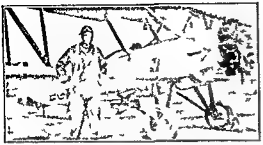


Chart 4



NB showing v ntu l tub below fuselage

labor for 32 hours at $2 50 per hour was $80 00

For the purpose of distributing Paris green any plane of any type may be used and a hopper as simple as the one above described can be installed by any good airplane mechanic

Adequate planes may be purchased as cheaply as $2 500 00 First class engines are produced for $4 500 and many cheaper grades (perfectly usable) are on the market

Good engines may be counted upon to give not less than 500 hours in the air — many of them will give more The following figures taken from cost of operation at Quantico during 1927 may be of assistance in helping to estimate the cost of this method of control on a commercial basis

AMOUNT AND COST OF MATERIALS
19 7

Pa is g en 31 0 lbs	$53 00
Soapsto e 5800 lbs	9 00
Total cost fo material	$ 61 00
N mb f ac es of breeding u fac	800 acre
C t of m terial per acre for a o	$0 01
(F 19 6 this figure wa	0 7 4)
C t of h pp install d	$93 35
N gal gasoli e p r h	0 g 1
No gals yll d il per h u	1 gal
No a re d t 1 du i g 19	800
N h s f d ting flights	15 /3 hrs
No cr s dusted per ho r	364 ac e

The flights during two seasons at Quantico and the single flight near Bamberg demonstrate the diversity of type of plane that may be used We operated successively a TW 3 an NB 2 and a Ford Tran port The first two carried only 200 pounds at each flight the tran port carried 500 pounds Had we used a specially constructed plane capable of carrying 1000 pounds of dust we could have reduced the flying time 50 per cent or more

In other words, instead of only 364 acres per hour we could have dusted 728 acres per hour or 5 600 acres per day almost nine square miles. At that rate a properly equipped plane should handle 50 square miles a week This is its limit of operation as dustings at certain seasons are at seven day intervals However such a rate could hardly be maintained by a single plane Four hours a day for five days of each week would be a more practical estimate a unit of twenty square miles per plane

SUMMARY AND CONCLUSIONS

(1) Thirty three per cent Paris green in an inert dust is the most satisfactory mixture under all wind conditions

(2) One pound of Paris green per acre is the proper unit

(3) The number of dustings per season must be determined for each breeding area

(4) Intervals between dustings varied with the season At Quantico they were from 6 to 13 days

(5) Paris green soapstone mixtures when distributed by airplane penetrate all forms of vegetation indigenous to the Atlantic seaboard

(6) Practically any type of plane is suitable for distributing Paris green

(7) A simple box with sloping sides makes a suitable hopper No agitator is necessary with Paris green

(8) One plane could handle twenty square miles of breeding surface

(9) The material costs approximately seventy cents per acre per season

(10) Our experience indicates that airplane dusting of uncleared areas is commercially feasible

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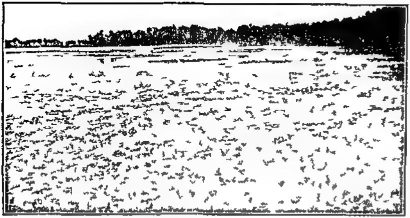
3 William L L J and Cook S P i Gr en appli d b Airpl 1 th Control f An ph l P od tion Pub Health P p I pp 4 9 490 F b 15 19
4 Pers 1 C mm nication from P a of A ron u tic N y I pt
P ivat C mmunic tion
6 M sq ito Co trol by Airpl i S th Carolina, Pub H alth R p pp 3 3 S pt 3 19 7

DISCUSSION (Abstract)

D B 3 K B eau of F tomology Mo d La—The w rk reported conf rms the sat factory results obtained by these authors in 19 6 Before the work at Quantico was started it happened that I had an opportunity to see the cond tions there and to confer with the men in charge regarding the fea bi ty of the operations. I hould like to add one or two points from my own e periences with airplane du ting during t e past few years in the swamp country of Lou siana where we have a great r variety of condit ons than those at Quantico As I recall it practically all of the breeding



Typical eel gra   mat (valli neria speiral s) in Quantico Bay

eleven miles from Bamberg South Carolina This flight has been described elsewhere[8] The results were as follows before the flight, *Anopheles quadrimaculatus* larvae averaged five per dip two hours after the flight, a very few first and second stage larvae could be found The following morning 703 dips over 12 acres of that portion of the pond which had previously shown the heaviest breeding revealed exactly two live larvae and ninety four dead ones In this case, one pound to the acre was distributed after a shower of rain, when the vegetation was wet We have been told that there are places covered by heavy vegetation where Paris green and road dust has been applied without success The attempts in these places were abandoned for the reason that the dust did not penetrate the vegetation

On July 10 an experiment was carried out for the purpose of again testing the penetration of the dust through dense vegetation A portion of upper Chopawamsic Swamp was chosen where very dense vegetation was found A narrow path was cut in the swamp to facilitate getting in and out, and pans of larvae with glass slides nearby were set out at 25 foot intervals each pan being set 10 to 20 feet away from the path and always under the heaviest growth Three of the pans were under dense low growth which was under alders the whole being overshadowed by birch One pan after being placed was covered with low bushes which had been cut at a distance One pan was set beneath a wild grape arbor which was overshadowed by birch and which itself covered closely growing weeds about three feet in height The plane delivered approximately one pound of Paris green per acre and four hours later the mortality in each pan was practically 100 per cent The slides nearby showed Paris green particles varying from 28 per square inch to 69 per square inch In addition much of the vegetation was examined by hand lens and but little Paris green could be found on the leaves The lens revealed much more Paris green on the water itself than on any portion of the vegetation examined

In order to demonstrate this method of control in uncleared impounded areas a Navy plane dusted an entirely uncleared pond of 500 acres

EQUIPMENT USED IN 1927

The plane designated for use this year is known as an NB 2 It has a low landing speed, is easily maneuvered, and has proved to be very satisfactory for air dusting work This plane carried an average load of dust of about 300 pounds, and generally flew at approximately 60 miles per hour

Lieutenant F G Cowie was again detailed to equip the plane with the necessary dusting apparatus He prepared a simple hopper of 20 gauge brass 30 inches high 25 inches wide, and 30 inches long From top to bottom this was V shaped in cross section He placed the hopper in the after cockpit with a cable outlet control going forward to the pilot's seat The filler hole was 7 1/2 inches inside diameter constructed with a self locking rubber gasket top The outlet measured 7 1/2 inches by 9 1/2 inches and was fitted with a sliding door held shut by means of stop bolts The cable control carried to the forward cockpit terminated in a handle which was easily reached by the pilot This handle was so mounted as to slide on a bar and permitted regulation of the degree of opening No agitator was necessary within the hopper The dust fell by gravity to the venturi tube mounted below the fuselage The tube this year was much smaller than last measuring 2 feet 5 inches long by 8 inches square at the mouth 7½ inches in the center and 12 inches square in the rear The outlet of the hopper opened into the constriction of the venturi tube the point of greatest air velocity The dust was blown out of the tube in an even cloud and was well broken up The material for this apparatus cost $13 85 the

NB showi g ventu i tub b l w fus l ge

labor for 32 hours at $2 50 per hour was $80 00

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AMOUNT AND COST OF MATERIALS
19 7

Pari gre n 31 0 lb	$ 3 00
So pstone 5800 lbs	9 00
Total cost fo materi)	$ 61 00
Number f ac es of bre di g su fac	800
C t of m te ial p r acre fo	$0 701
(For 19 6 this figu wa	0 4)
C st f h pp i stall d	$93 25
N g l ga oil p r hou	0 g l
N gal cyli d r il p h r	1 gal
No re d sted d i g 19	5 00 ac e
N hou of d ti g flight	15 /3 hrs
N acre du ted p r hour	364 ac s

The flights during two seasons at Quantico and the single flight near Bamberg demonstrate the diversity of type of plane that may be used We operated successively a TW 3 an NB 2 and a Ford Transport The first two carried only 200 pounds at each flight the transport carried 500 pounds Had we u ed a specially constructed plane capable of carrying 1000 pounds of dust we could have reduced the flying time 50 per cent or more

In other words instead of only 364 acres per hour we could have dusted 728 acres per hour or 5 600 acres per day almost nine square miles At that rate a properly equipped plane should handle 50 square miles a week This is its limit of operation as dustings at certain seasons are at seven day intervals However such a rate could hardly be maintained by a single plane Four hours a day for five days of each week would be a more practical estimate a unit of twenty square miles per plane

SUMMARY AND CONCLUSIONS

(1) Thirty three per cent Paris green in an inert dust is the most satisfactory mixture under all wind conditions

(2) One pound of Paris green per acre is the proper unit

(3) The number of dustings per season must be determined for each breeding area

(4) Intervals between dustings varied with the seasons At Quantico they were from 6 to 13 days

(5) Paris green soapstone mixtures when dis tributed by airplane penetrate all forms of vege tation indigenous to the Atlantic seaboard

(6) Practically any type of plane is suitable for distributing Paris green

(7) A simple box with sloping sides makes a suitable hopper No agitator is necessary with Paris green

(8) One plane could handle twenty square miles of breeding surface

(9) The material costs approximately seventy cents per acre per season

(10) Our experience indicates that airplane dusting of uncleared areas is commercially feas ible

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DISCUSSION *(Abstract)*

Dr B *K* *g Bu eau of E tomology Mound La* — The work reported confirms the satisfactory results ob tained b these authors in 19 6 Before the work at Quant o was tarted it happened that I had an oppor tunity to see the conditions there and to confer with the men in charge regard ng the fea ibility of the operations I should like to add one or two points from my own experiences w th airplane du t g during the past few years in the swamp country of Louisiana where we have a greater variety of conditions than those at Quan tico As I recall practically all of the breeding

area there is about a half mile in width and with the dust released at an altitude of 50 feet or more the proportions and quantity of Paris green as worked out by the authors are undoubtedly quite correct for that particular place Many of our swamp lakes however are long and narrow and a much smaller proportion of Paris green is often of decided advantage in the saving of material and much closer flying is frequently necessary to cover the area completely This is particularly true when the wind is blowing and in practically all of our work more or less wind was encountered On a bayou of from 50 to 100 feet in width or lakes up to several hundred feet in width the pilot may misjudge the wind enough so that most of the area is missed the first time and a second or third trip is required to complete the treatment Under these conditions as well as others that might be mentioned a great deal more wastage occurs with mixtures as strong as 33 or 50 per cent Furthermore in breeding areas which are not protected by trees much less poison is required than one pound per acre In our dusting operations in 1925 a breeding area approximately five miles long by a quarter of a mile wide was dusted several times during the season and records kept of the amount of material used One part of the area consisting of about 240 acres contained no vegetation other than a thick growth of potomogeton which came just to the surface of the water On one occasion under favorable wind conditions our estimates showed an average of less than two tenths of a pound of Paris green per acre for this part of the lake with a larval mortality of practically 100 per cent and even with this small quantity part of the area received more dust than was required for effectiveness The actual amount of Paris green used here was 45 pounds a saving of 195 pounds at the rate of a pound per acre To be sure the results may be more certain with larger quantities but with our longer breeding seasons and the necessity of more frequent applications the expense of materials must be kept as low as possible

Dr Cook (closing) —I am sure the cost of material can be reduced by using a greater dilution and also by reducing the rate of discharge of dust It is also apparent that the poundage per acre will have to be determined for each locality in which the method is applied For example Dr King in his work in Louisiana was able to obtain good results with 1/4 pound of Paris green per acre whereas we have been forced to use one pound

Paris green costs us approximately 17 cents per pound and the diluting dust 0 5 cent per pound

A SUCCESSFUL METHOD OF REARING ANOPHELES LARVAE*

By W H W Komp,†
Greenwood, Miss

The recent publication of a paper by Boyd[1] on a method of feeding anopheles larvae has led me to publish a method I have used over a period of years with success Dr Boyd uses yeast as a food, supplying it in shallow pans equipped with siphons for changing the water, and with marble chips to maintain the proper acidity of the water Recent unpublished work of Dr M A Barber on food organisms in pure cultures has shown definitely that yeast either living or dormant, is not a very successful medium for the growth of anopheles larvae It is most probable, therefore, that the yeast in Dr Boyd s method acts merely as a substratum for a kind of soup of bacteria, fungi, yeasts and other contaminants upon which the larvae feed In some few experiments I have made with yeast as a food I got very variable results Using Fleischmann s yeast in cups, without changing the water, I got prompt and immediate death during hot weather, but was fairly successful although not notably so during the cooler spring and fall weather

The only advantages claimed for my method are its universal applicability, its ease of operation in that no apparatus except china cups and lantern chimneys are required and the high percentage of successful rearings, even from the egg stage

It may be thought by some unfamiliar with the difficulties that it is an easy matter to rear anopheles to maturity from the egg but the literature is full of citations to the contrary Freeborn states that working with *Anopheles maculipennis* in California under as nearly natural surroundings as possible he was able to obtain only 8 to 10 adult mosquitoes from about 200 eggs Swellengrebel[3] states that he never was able to obtain anywhere near 100 per cent emergencies from a known number of eggs as the larval mortality was great no matter what the food He also emphasizes the increased difficulty of rearing the larvae in hot weather a point I have noted with grief and can confirm One thing which may make considerable difference in the mortality statistics is that it is much easier to rear strong healthy imagoes from quarter grown larvae but there is a very heavy infant mortality among the newly hatched larvae which seem to die no matter what they are fed or how Dr Boyd states that he obtained 100 per cent emergencies in his experiment I do not know whether this refers to rearings from eggs, or from young larvae

METHOD

Anopheles larvae are surface feeders almost exclusively when there is sufficient surface scum to afford them nourishment In nature this is

*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fir t Annual Meeting Memphis Tennessee November 14 17 19 7

†Associate Sanitary Engineer U S Public Health Se vice

almost always the case The success of the method I have used is perhaps partially due to its simulation of natural conditions in this respect I get a mass of green algae the common *Spirogyra* heat it enough to kill it put the mass into a tall battery jar, and fill it to the top with tap water In twenty four hours a thin organic scum forms This is composed of algae infusoria and protozoans of various kinds Portions of this scum are looped off with an over size loop and placed on the surface of water in ordinary china cups in which the larvae are placed Thin scums are used to feed the smaller larvae while thick scums in large quantity may be placed in the cups with the larger larvae As pupation occurs lantern chimneys having one end closed with mosquito netting are placed over the cups to retain the imagoes as they emerge The best type of chimney for this purpose has been found to be what is known to the trade as the Dietz Little Wizard chimney This is small enough to fit over the china cups u ed

Apparently with this method there is no limit to the number of larvae one may place in a cup provided sufficient food is given them As at high temperatures the larvae are very voracious it is often necessary to feed them two or three times a day if it is desired to obtain imagoes in the shortest possible time Otherwise one feeding a day preferably in the morning is sufficient and is best done after the emerged adults are removed in the lamp chimney and killed

Some may ask why it is still necessary to determine the species of anopheles from imagoes when it is easy to determine it by using the larval characters discovered by Paul F Russell[4] In my experience these characters are reliable but in the tropics and in the Southwest where other species of anopheles occur besides *quadrimaculatus punctipennis* and *crucians* the method may be used to determine the species by rearing the larvae to imagoes In any case it is necessary to have larvae full grown to be sure of the Russell characters and any method which is successful and not too cumbersome is useful The whole point of the method is that by u ing clean water and feeding only so much as the larvae will clean up contamination of the water is prevented to a large extent with consequent lessened mortality of the larvae

Using this method I have successfully reared from egg to imago in 10 days and obtained 11 imagoes from 15 eggs in one checked experiment and 41 imagoes from 65 eggs in about 15 days. These are merely the results of accurately checked experiments in which known numbers of eggs were used The true value of the method cannot be judged by so few examples but by its success in bringing to maturity larvae in every stage day after day and season after season

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LIMITATIONS IN THE USE OF TOP MINNOWS IN ANOPHELES MOSQUITO CONTROL IN CALIFORNIA AND OBSERVATIONS ON ANOPHELINE FLIGHT ACTIVITIES*

By W B HERMS †
Berkeley Cal

Among the several matters under observation relating to our California anophelines in the past few years two points have been of major interest to us namely first the use of top minnows (*Gambusia*) in control and second early and late flight activities A brief account of our observations concerning these matters may not be inappropriate in connection with the 1925 meetings of the National Malaria Committee of which the writer is a member

Top Minnow Plantings—A very large percentage of the California anophelines breed along the edges of transient streams particularly in the spring and early summer after the streams have begun to recede leaving pools along their courses During the winter season of heavy rains these streams are considerably swollen becoming rushing torrents after every heavy rainstorm but by late June or early July they present dry beds unless they are utilized as drainage canals for irrigation projects When the latter occurs these small creek courses alternately become flowing treams and dry beds unless special precautions are taken to keep some irrigation water constantly flowing

Read bef National Mal ria C mmitt e (Con f renc on Malaria) meeti g conj i tly with So th rn M di al A ociatio Twenty First An u l Meeting M mphis T n Novembe 16 17 1925

†Prof sso f Parasit l gy Univ rsity of California.

The pools left over by the receding streams are usually prolific sources of anopheline mosquitoes and present together with irrigation both in the ditches and in the drainage to creek beds and elsewhere problems of considerable importance These conditions are ruinous to the economic use of top minnows Winter torrents wash the minnows down to the larger streams from which they do not return and the hot summer temperatures rapidly dry up even many of the deeper pools that might otherwise afford a refuge for those that might not have been washed away during the winter

The situation is well illustrated in our experiences with *Gambusia* in a creek adjacent to the University Farm at Davis California Plantings were made in the fall of 1923 in a branch of Putah Creek which theretofore always furnished a supply of anophelines for the University Farm in spite of oiling which was difficult to accomplish on account of the underbrush steep banks and other obstacles The winter of 1923 24 was an exceedingly dry one and in the spring of 1924 the minnows were found to be present in large numbers By July the creek bed adjacent to the Farm was dry with the exception of a small portion about seventy five yards long where the effluent from the creamery condensers maintained sufficient water to support thousands of *Gambusia* The winter of 1924 25 was a normal one and on two occasions the waters of the creek rose to the level of its banks (twenty feet) and in the low water which followed no top minnows could be found even by seining No minnows had returned by June oiling having again been resorted to in the interim when during that month several thousand *Gambusia* were again planted

Profiting by the experience gained during the dry season arrangements were made with the irrigators to direct sufficient water through the creek at all times to maintain at least a slight stream throughout the summer The irrigation water was cut off in October and the creek reverted into a series of separate pools all teaming with fish which did excellent work in mosquito control

Now should the winter of 1925 26 be a wet one no doubt all our minnows will again be washed away Arrangements are being made to over winter several thousand minnows in a concrete tank for planting at an early date next year in case the present population is washed out as it was last winter by the high water

Wherever *Gambusia* can be maintained mosquito control is excellent but this type of control is practical in only a very small percentage of the mosquito breeding locations of California The tendency has been to plant these top minnows without following up the results and in some localities at least an increase in malaria can be traced to an over dependence on the top minnow

Flight Activities of Anophelines—There is much to be learned about the general flight activities of our anopheline mosquitoes Each year there occur rather regularly early and late flights For the neighborhood of Vina California about one hundred miles north of Sacramento the early flights take place within a few days of February 22 irrespective of the preceding temperatures as reported to the writer by Dr S B Freeborn At Davis California and Sacramento locations about fourteen miles apart the spring flight began on February 10 as recorded this year

At Davis where good local control is exercised no anophelines have been present for two seasons during the months of March to September However each year during the latter part of September and persisting during the first half of October large numbers of anophelines appear which bite readily by day as do the spring migrants It appears that two distinct migrations occur in California one in the spring and the other at the close of the breeding season Males evidently do not participate in these flights

An invasion of hordes of anophelines into localities where control is being exercised creates a situation that is not altogether flattering to the man in charge of anti mosquito operations particularly in view of our contentions that anophelines do not fly far from their breeding places which is true for the active breeding period but for California at least must be modified to exclude the two great annual flights

These flights are probably dispersal flights and advantageous to the species What distance they cover we do not know positively Although there is always much solicitude concerning malaria infectivity during the flights this is not justifiable except to a certain degree in the case of the autumn flight Here again we have much still to learn in which matter laboratory investigations are now in progress

THE ANOPHELES DENSITY INDEX IN MALARIA RESEARCH AND CONTROL WORK*

By W. V. King,†
Mound, La.

In analyzing or reporting the results of malaria and mosquito investigations it frequently becomes necessary to make use of figures comparing the abundance of anopheles under different conditions. The methods which have been employed by different workers have usually been varied to meet local conditions or special problems and as yet little effort has been made to obtain such records in a more standardized way. It has occurred to me, as it probably has to others, that there would be a number of advantages if more uniformity could be obtained in connection with the work on our Southern anopheles so that different localities and different investigations might be more readily compared.

In our studies in northeast Louisiana we have constantly had occasion to make use of such comparisons as, for example, the comparative abundance in different local areas, the variation in abundance during the different months and the different seasons, the relation of abundance to the blood feeding habits and to malaria incidence and for other purposes.

I believe also that in determining the results of control measures more use could be made of the density index than has been the case in the past.

In malaria control campaigns a great deal of effort has been expended in determining the effect on the malaria rate and such records are essential since the object is the reduction of malaria. However, as most malaria control work is based upon mosquito control it is evident that for practical purposes the accurate determination of the extent of mosquito reduction is equally essential and gives more immediate information.

An additional point, especially as regards uniformity of records, is that many valuable data might be added to the malaria statistics now being accumulated under different conditions if we had the correlated facts as to mosquito density under the same conditions. We are familiar with the expression "the effective number" as applied to yellow fever mosquitoes and a similar situation undoubtedly exists in the anopheles-malaria relation, as has been theoretically demonstrated by the mathematical work of Ross[1] and Lotka. In the yellow fever work a more or less systematized method of determining the prevalence of *Aedes aegypti* has been adopted but as yet we have little information as to the density limit which could be safely permitted in malaria control.

Anopheles quadrimaculatus is now generally considered to be the principal transmitter of malaria in the Southern United States. Perhaps the varied conditions under which it occurs in the different localities will make the problem of measuring density on a comparable basis quite difficult. Nevertheless it may be feasible to do so in many rural communities and the purpose of this article is to discuss some of our own results in this connection with the hope of bringing out an exchange of information among those who have had related problems.

During the several years that the field station of the Bureau of Entomology has been located at Mound, Louisiana, a great many records have been accumulated as to the habits of larval and adult anopheles and their prevalence under varying conditions.

With regard to larval density we have developed a method for comparing abundance in which a number of stations are selected in the various types of breeding places and at these stations biweekly or monthly records are kept showing the width of the water area, the general surface conditions and the average number of larvae collected by dipping in favorable places. From the measured widths we obtain the surface water index for the locality and this in conjunction with the number of larvae per dip provides a method for comparing larval

TABLE I

COMPARATIVE ANOPHELES DENSITY, 1919 TO 19 6

Hecla Plantation, Mound, La.
(Based on the May to September average of under houses collections and ...)

Year	No. Houses	No. of Anopheles per house per day: Male	Female	Total
1919	1		16	1
19 (		3	4	6
1 1	0	4	3 5	4 4
19	0	5	5 9	613
19 3	9	44	6	7 6
19 4	14	1	4	5
19 5	16		13	1
19 6	14	11	[illegible]	66

*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-First Annual Meeting, Memphis, Tenn., November 14-17, 19[illegible].

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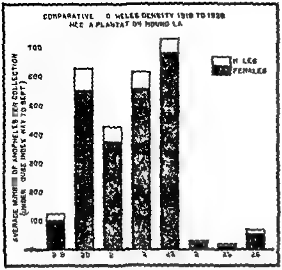

Chart 1

abundance during the different months of the year and for different years. One of my associates, Mr. G. H. Bradley, has made further studies[3] to determine the output of adult anopheles from unit areas of water as compared to the prevalence of larvae. While this has all given much useful information in our biological investigations, it appears to be a less practicable method for comparison of different localities than adult density, although of course local studies of larval distribution are indispensable in any control work.

In the early work at Mound under Mr. D. L. Van Dine, numerous collections of adult anopheles were made in all types of shelters to determine their daytime habits and from these it was learned that the principal resting places of fed and inactive mosquitoes were inside and underneath the dwelling houses and in stables and other out buildings. In the woods near the breeding places many adults are to be found in hollow trees during the daytime but the majority of these are newly emerged and still unfed. From the sum total of our observations since then we have concluded that in our locality the great majority of anopheles which come to feed on man or the domestic animals remain in or about the houses and farm buildings the following day. This habit therefore provides an opportunity to determine the approximate total number of mosquitoes to which such hosts are exposed.

The territory about Mound is divided up into the typical cotton plantations of the Mississippi alluvial lands or Delta and cultivation is carried out largely by negro tenants. The tenant dwelling houses are all quite similar in construction, consisting of two, three or four rooms and are elevated on blocks eighteen inches to three feet or so in height. This elevation of the houses provides one of the favorite resting places for adult mosquitoes and hundreds or even thousands are often found underneath. The out buildings vary in number and construction but may consist of a cotton and corn crib and a loosely constructed stable and chicken house. A common building is a combined crib and feed room with a lean to on each side for the stock and implements. Many of the out buildings are not highly favorable as mosquito shelters on account of the open construction.

In 1919 a series of houses scattered about over one of the plantations was selected for regular monthly collections of all anopheles about the houses and out buildings. In analyzing these records at the end of the season it was found that 76 per cent of the mosquitoes collected during the summer months had been taken from under the house. It was also shown from this year's records as well as those of previous years that the density was greatest during the months from May to September, being much reduced usually in April and October and almost negligible in the other months.

In 1920 a second plantation and in 1921 a third were included, the collections, however, being limited to inside and under house collections in 1920 and to under house collections only in 1921.

During 1922, in connection with an investigation of the blood feeding habits of anopheles and their infection under natural conditions,[4] complete monthly collections were again made at the entire series of selected houses on the three plantations, the records covering a period of seven months and a total of 46 houses. At the end of this season, with the assistance of the Department of Biometry of the Johns Hopkins School of Hygiene, an analysis was made of the records thus obtained for the four years and some of the salient points of the results may

TABLE 2

ANOPHELES DENSITY IN DIFFERENT LOCATIONS ON THREE PLANTATIONS

Average number of males and females per collection from May to September 19

Location	Hecla	Killarney	Algodon
Inside house	5	31	233
Under house	613	237	2703
Out buildings	347	115	1103
Total	1035	383	3038
Per cent under house	59%	6 %	65%

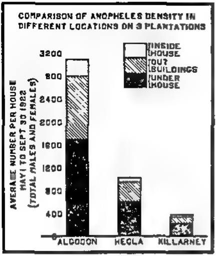

Chart 2

be briefly pointed out The inside house collections were the most variable of any of the different locations and when taken by themselves furnished a poor index of total abundance The principal resting place was underneath the house and these collections were highly correlated with total abundance a further high correlation was found to exist in the collections at the same house for different months of the season and for different seasons From the standpoint of adult habits this last observation is of considerable interest since it may be taken to mean that mosquitoes are attracted to a particular place in more or less the same relative proportions for month after month This tendency has been further shown in other records which we have and in which daily or weekly counts have been made at adjoining places over a considerable period of time A peculiarity of the habit is that of two near by places which to all outward appearances are quite similar one may consistently have several times as many mosquitoes as the other and this has made it necessary to include more places in the collections than would otherwise be required in order to have a satisfactory average

Since 1922 in order to maintain a record of seasonal abundance and variation without an undue expenditure of time we have selected under house counts made once each month from May to September inclusive as our density index Before adopting the count in place of actual collections its feasibility was determined by counting the mosquitoes under a series of houses previous to making complete collections This had shown that quite accurate counts could be made by a careful worker after a little practice A flashlight is necessary for examining the dark corners and with a hand tabulator separate counts of males and females can readily be made The identification of the different anopheline species is more difficult *Anopheles punctipennis* and *crucians* normally occur only in very small numbers in our locality but in areas in which they are more numerous it would probably be necessary to make partial collections along with the counts to establish the proportion of each species

The counted numbers for all houses on one plantation are averaged for the monthly density rate The monthly rates for the five summer months are then added together and again averaged for the seasonal index which is expressed as the number of anopheles per house per day We now have such an index for the Mound area for the eight years from 1919 to 1926 inclusive the 1927 record having been interrupted by the overflows of the Mississippi river in May and June In addition as mentioned previously we have two entire season s records and many other collections as well showing total abundance in all locations and the proportion of each of our three species

In regard to the selection and number of places to be included in such records several factors were necessarily considered Vacant houses were not used by us and those occupied by only one or two persons were avoided when practicable as were also houses or other buildings having inaccessible shelters Otherwise typical places as well scattered as possible were made use of When for any reason a house could not be used the following year a nearby place as similar as possible was substituted

The number of houses required to give reliable records depends upon the variation in density and as a rule the smaller the unit of

TABLE 3

ABUNDANCE OF ANOPHELES BY MONTHS ON HECLA PLANTATION FROM APRIL TO OCTOBER, 19

Month and day of collection	Average No. per collection from house and outbuildings: Male	Female	Total
April 7	1	0	71
June 5	69	830	899
July 11	141	1490	1631
August 8	84	12[illegible]1	1359
August 6	45	596	641
September 21	23	6[illegible]2	645
October 25	3	[illegible]	14
May to Sept average	3	96	1025

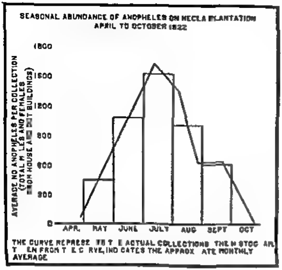

Chart 3

area the less is the variability In our work we have made an effort to keep the probable error of the mean as determined by statistical methods within a limit of about 10 per cent of the mean This limit has not however always been maintained, usually due to the fact that a single house might have an excessively large number of mosquitoes and as a result the entire series would show a high degree of variation In *Table 1* is shown the number of houses included in the averages each year for one of our plantation units The number of places occupied by tenant families or day laborers varied from about 85 to 95 so that the ratio of houses at which counts or collections were made was more than one out of five during the first four years of the record and more than one out of seven during the last three years when as a result of droughts the density was much reduced In 1923 only nine houses were included but this number was considered to be inadequate

Herein are given several tables and charts showing certain comparisons which may be made from our density records The figures appearing in the tables are all from averages but for present purposes the decimals have been dropped and only whole numbers given

While comparative abundance has usually been determined by catching or otherwise obtaining the total number of mosquitoes in a given location, mention should be made of another method in which the collecting time is limited to a period of ten minutes or so at each place and relative densities are expressed as the number caught per minute or per man hour of search This system would appear to have certain advantages, especially in the saving of time, and has been employed by Smillie[5] in his studies of malaria in Alabama and by Boyd[6] in his work in North Carolina Our own results with the method in the Delta have not however been satisfactory since it was found to be impossible under many conditions to obtain a proportionate part of the mosquitoes from different locations in a limited time This was especially true where the mosquitoes were fairly numerous and one series of comparative collections may be mentioned in which the relative total density was shown to be nearly twice as much as that indicated by short period catches

As a means of saving time in obtaining density records for purely comparative purposes we have found that the counting of mosquitoes about the buildings may be employed to advantage if it is properly checked up for accuracy which may consist of a recount of each place by the same or another person until a single count can be relied upon or, as has been done in some of our work collections may be made for a time to verify the counts

If counting is to be employed instead of collecting locations should be selected in which the resting mosquitoes can readily be seen with the aid of a flashlight In this connection we have found that counts inside the dwelling houses are not satisfactory because of the many articles of furniture and clothing behind which the mosquitoes may hide Counts as well as collections are also unsatisfactory in buildings having high rafters or in those of unusually rough construction

Unfortunately for the purposes of obtaining comparative statistics localities differ in the kind of shelters offered for resting anopheles and many places do not have the uniform living conditions found in the Delta under the negro tenant system of farming However in concluding this discussion there are two suggestions which may assist toward the end of securing greater uniformity of density records in the rural communities of the South The first is that a sufficient number of preliminary collections be made in each locality to determine the principal resting places the approximate total abundance of anopheles and the proportion in each general type of shelter When feasible such observations should extend over at least one entire season since a certain amount of variation in the proportions may be expected at different times of the year and with different densities The

second suggestion is that if one type of shelter is to be selected for the density index it should be one of the principal resting places and should be reasonably uniform at the various dwellings or stations where counts or collections are to be made

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DISCUSSION (*Abstract*)

Dr John A Ferrell IHB New York N Y—I should like to ask Dr King if those records are for the period since the flood waters subsided and what the outlook is for the future Were your collections on a monthly rate?

Dr King—Yes

Dr Ferrell—Is it likely that the anopheline density in this section following the flood is going to rise again to the 1922 or 1923 level? Also are there any indications of an increase in the amount of clinical malaria?

Dr King (closing)—Replyin to Dr Ferrell questions our first complete count this year was made in August and at this time the density rate was fairly high but at least no higher than in some of the previous years By September the numbers had dropped off rapidly

Durin the overflow breed ng was very much scattered as there was an almost constant current which prevented the accumulation of debris except in occasional protected pots By the time the water had receded to its normal areas practically all of the smaller aquatic vegetation, including water lilies grasses ceratophyllum duck weed jussiaea and algae which afford protection and food for the larvae had been washed away or de troyed by the increased depth of the water It will probably be some time before the aquatic growth will become reestablished to its former condition

In regard to the malaria situation we were really expecting something of an epidemic especially in the local camps established for the returning refugees but so far as I have been able to learn there has not been a serious increase It was suggested by some of the local physicians that this may have been due to the lack of carriers since anopheles and malaria had both been much reduced as a result of the unfavorable mosquito breeding conditions during the past three seasons

SALT MARSH MOSQUITOES SOME PHASES OF THE PROBLEM IN SOUTHERN STATES*

By T H D Griffitts M D †
Biloxi Miss

"The control of all species of mosquitoes is sanitary work and should be promoted in every way by sanitary authorities

These are the word of Dr L O Howard until quite recently Chief of the Bureau of Entomology U S Department of Agriculture and the most distinguished entomologist in the world today

For a long time we have separated mosquitoes into two general classes disease carriers and non di ease carriers A more significant division from a sanitary standpoint would put mosquitoes into three classes (a) mosquitoes that are directly responsible for the transmission of pecific diseases (b) those that exert a less direct influence on individual and public health and hazard well being and (c) those that are harmless In the first class in this country are species of anopheles which transmit malaria and *Aedes aegypti* (*stegomyia*) the transmitter of yellow fever and dengue When or if these diseases are totally banished then these mosquitoes fall into the second class those that exert a less direct influence on individual and public health and hazard well being

As to the (b) class there are multiple pecies of many genera that through their bites irritate pester torment worry depopulate almo t devastate that decidedly lower physical fitness even to the point of definite though non specific illness The salt marsh mosquitoes are among the most notorious of this class The writer knows of instances and localities wherein these mosquitoes not only take the profits from business such as live stock and poultry raising but have actually cau ed the death of domestic animals Not only this but the hordes of salt marsh mosquitoes at intervals and over rather long periods have driven labor from the fields and forests slowed even stopped the wheels of indu try emptied hotels and pleasure resorts and closed public schools In general they have raised so much disturbance of that kind that only the

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*Re d before Section on Public Health Southern Medical Association Twenty First Annual Meeting Memphis Tennessee November 14 1 19 7

†Epid miologist U S Public Health Servic in charge of Survey of Salt Marsh Areas South Atlantic and Gulf States

brevity and force of a Sherman can define, that in the midsummer of 1926 the Congress of the United States appropriated $25 000 for the fiscal year 1927, and an additional $10 000 for 1928, to be expended by the U S Public Health Service in cooperation with the Bureau of Entomology of the Department of Agriculture

for a preliminary survey of the salt marsh areas of the South Atlantic and Gulf states to determine the exact character of the breeding places of the salt marsh mosquitoes in order that a definite idea may be formed as to the best methods of controlling the breeding of such mosquitoes

Then under class (c) there are several species of mosquitoes which do not bite, while others though blood suckers breed in small numbers or in such localities as not to constitute a menace With these only entomologists are concerned

In the South Atlantic and Gulf states, from Virginia to Texas both inclusive there are vast tracts of low lying lands that are wet and subjected more or less to being covered by tides These constitute the salt marshes In these states there is an aggregate of 5 600 000 acres of salt marshes, in round numbers as follows Alabama 34 000 Florida 680 000 Georgia 329 000 Louisiana 3,381 500 Mississippi 26 500 North Carolina 427 000 South Carolina 429 000 Texas 315 000 Virginia 206 000 From these figures it will be noted that within the State of Louisiana there is 58 per cent of the total salt marsh acreage of the South Atlantic and Gulf states and it is of interest to know that in that state is half of the salt marshes of the United States

To one unfamiliar with problems of this nature these enormous figures might be sufficient to discourage support of efforts at control Although there are millions of acres of salt marshes in the South Atlantic and Gulf states the Public Health Service feels that the task of control is not a hopeless one In the first place this survey has brought out the fact that the character of the marshes varies widely and that only a small proportion of them generally considered constitutes actual or even potential breeding areas In many sections vast expanses of marshes are daily covered at high tides These are not producers of mosquitoes Consequently one of the first objectives of the survey was the classification of the marshes according to tidal and other influences which bear a direct relation to salt marsh mosquito production

With the limited funds the short time and a coastal zone extending from Norfolk Virginia to Brownsville Texas over which to extend a preliminary survey 'of the exact breeding places of the salt marsh mosquitoes " it was at once recognized that the survey should be conducted along definite lines, namely selection of (a) certain more or less typical areas in which to conduct intensive studies of the species of mosquitoes, their egg laying habits, larval development, flight habits and conditions influencing these, character of soils and vegetation influence of tides and climatological conditions, natural aquatic and aerial enemies larvicides and other methods of control under varying conditions and (b) more or less rapid surveys in marsh areas over the whole coastal territory and the collection and compilation of reliable data from all available sources relating to the problems of the different regions For the studies in detail most of the work has been conducted from the field headquarters of the survey at Biloxi Mississippi while other intensive studies have been carried on at points in Florida and North Carolina and at present at one point in Louisiana

Time will not permit, in this brief paper to dwell upon the mass of information already obtained by the preliminary survey However, it will be in place to take up something of the types of mosquitoes, their habits some suggestions as to control measures and the interests concerned in the problems

The most intolerable pest and nuisance among the salt marsh mosquitoes is *Aedes sollicitans* generally known as the notorious 'New Jersey mosquito It is the chief representative on the long distance migration flights that have occurred inland from our Southern marshes Second in importance is *Aedes taeniorhyncus* although its sustained flight apparently is not nearly so great as that of *sollicitans* *Culex salinarius* is a poor third in the race *Anopheles crucians* and *Anopheles atropos* (a spotless winged member of the malaria carrying genus) are found in great numbers and are vicious biters in many of the marshes As a salt marsh breeder *Anopheles crucians* occurs generally in the South Atlantic and Gulf states and at times even outnumbers and out bites the non anophelines present Aside from being a fresh water species too *Anopheles crucians* breeds in various degrees of salinity sometimes in water of even a higher salinity than the sea water *Anopheles atropos* concerning whose life history we knew little prior to this survey has been found to breed in salt water only apparently the higher the salinity the better This is one of the most intrepid biters found in the marshes and at times near

its breeding grounds occurs in numbers greater than all other species combined We have not worked out its role as a malaria vector although it has been found to enter houses freely and bites by day and by night

The egg laying habits of the salt marsh aedes play a part in mass production of these species Unlike anopheles for instance aedes lay their eggs on the marsh soil . When there is a drought the eggs are continuously deposited on the dry marsh even for months Then the drought is broken by rains or the marsh is flooded by unusually high tides or these conditions combine Within an hour eggs begin to hatch and the result may be billions of mosquitoes Flight may then take place as merely a dispersal or with prevailing breeze (but not strong wind) and proper temperature and humidity a migration flight may occur extending in some instances 30 to 40 miles inland

Various methods of control are being studied and limited areas have been selected for experimental work There are areas where gravity drainage is both quite effective and economical while in others diking and pumping is the only feasible plan On account of the cost of filling this is only practicable where the demand for such reclaimed land makes the operations profitable On the other hand there is great promise in the application of larval poisons from airplane or land machines The time may not be far distant when a cheap egg destroyer may be applied and we need not wait for even the larval stage Again the chemist may develop a poison gas against the winged insect that will be non toxic to man and to other forms of valuable life

The Congress of the United States has recognized the salt marsh mosquito problem as one of interstate importance in general welfare and while the apportionment of the appropriation made would be only six and a quarter mills to the acre in the territory of the survey yet we feel that a very necessary step has been taken which should eventually lead to satisfactory control of the tormenting salt marsh mosquitoes State county and municipal officials commercial organizations citizens individually and as organizations industrial and health interests are vitally concerned Further to permit this perfidious pest parading as an uncrowned monarch to preempt and rule over some of the choicest sections of the Southland as is the case today would be to admit defeat of man s ingenuity science and skill business acumen and political sagacity

DISCUSSION (*Abstract*)

Mr J A LePrince Memphis Tenn —I believe that the results of the surveys and studies bein made by Dr Griffitts will be of considerable benefit to many communities

Also the elimination of the sources of the salt marsh pestiferous mosquitoes will result in increasing property values to such an extent as to produce a large annual income to the county and to the state Recent investigations have also shown that feed grasses for stock can be grown on some parts of what we call the salt marsh meadow lands

Dr Griffitts (closing) —I would add nothing at this time except to center your thoughts on the great importance and extent of the salt marsh mosquito problems of the Atlantic and Gulf coasts If solution were impossible money expended on surveys would be wasted. Control is possible and surveys in detail should follow the present preliminary survey funds for which are provided only to the end of the fiscal year June 30 19 8

AUTHOR S NOTE—An additional Congressional appropriation of $15 000 was made for the fiscal year 1928 to further extend the survey

OIL LIBERATOR*

By WILLIAM O WETMORE M D †
Schofield Barracks Territory Hawaii

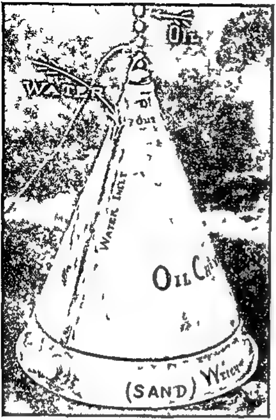
It is a well known fact that mosquitoes breed in water If the water is oiled the larvae coming to the surface are suffocated

The device shown herewith is designed to oil waterways economically This comprises a conical can with a diaphragm forming a receiving compartment for sand to sink it while the upper chamber thus formed is to be filled with a coal oil mixture The capacity of this chamber in the various cans is one to five gallons respectively A tube leads from near the apex to the lowest part of the oil chamber which acts as a siphon for water displacing the oil When the can is tossed in the water it sinks and bubbles of air escape followed by droplets of oil the rapidity being governed by the size of an opening in the top of the can

The can must be fully filled with sand and water to sink As the oil droplets burst on the surface they then spread and are carried in a wide rift over the surface filming it evenly The best mixture for fresh water is about one part coal oil and four parts fuel oil (Diesel) On brackish water the Deisel oil need not be diluted

The advantage of this method is the ease with which a great area may be controlled by carry

*Received for publication December [illegible] 1927
†Maj Medical Corp U S Army



ing a truckload of cans around over a section and tossing them in the pools where they automatically oil the ponds This gives the engineer not only quick action but makes it possible for him to know the amount of oil and overhead expense in his estimation of cost The cans have a cord attached with a cork so that they may be recovered and refilled Even if this process takes a week the cans can be back in the ponds in plenty of time to catch the next brood of mosquitoes

The gallon cans are about a foot high and the five gallon two feet high They are made of heavy galvanized iron and by the action of the oil last indefinitely

Our experiments indicate that a five gallon can will control an area as large as a city block and keep it oiled if changed three times a month

One feature of this oiler is that in places where overflow occurs the can will oil as soon as it is submerged and stop when the water subsides

Attention is invited to the ease and cleanliness of this method in stimulating the lay members of communities independently to rid themselves of the mosquito pests

One may use a greater quantity of a better oil mixture, and it still costs a fraction of other methods

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MALARIA CONTROL WORK IN ALABAMA PROGRESS REPORT (1927)*

By S W WELCH, M D †
Montgomery, Ala

An ounce of prevention is worth a pound of cure

The program in connection with the enforcement of the regulations which has been carried out on impounded water projects since 1923 bears out the above maxim There are few if any counties in the State of Alabama in which the people are not acquainted with the responsibility assumed by any person who impounds water The malaria epidemics which followed the impounding of water previous to the passing of the rules and regulations as exemplified by the Gantt outbreak have brought anew to the attention of the people the fact that newly impounded water causes sickness

During the past year in enforcing the preparation and maintenance of impounded projects it has been necessary in only one instance to bring pressure to bear through the Attorney General s office In all seventy one inspections were made on the projects under permit with the result that (a) seven ponds were caused to be drained and re cleared (b) four were found to have had the dam washed out and the projects abandoned in three instances (c) two projects had not been undertaken although permits had been issued

Lake Martin the largest artificial reservoir in the South comprising forty thousand acres with a shore line of approximately seven hundred miles, was the only project to require added control work and detailed investigations Owing to the physical condition of the lake at the 147 foot elevation it was found impossible to control the *Anopheles quadrimaculatus* production in a certain restricted area Mr C C Kiker, a state engineer spent two weeks on the project working out methods of control and trying out various combinations of kerosene and crude oil effect of wave wash on exposed shore lines and possibilities of control by use of Paris green Lowering

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*Report to National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Twenty First Annual Meeting Memphis Tenne Nov mb 14 17 1927

†State Health Officer

of the water level two feet changed the whole situation and the anopheline production was completely controlled. Mr. Kiker also determined in reference to the flight range of Culex that a number of the ten thousand stained specimens were recovered a distance of two miles from the point at which they were liberated.

During the winter months a survey was made of the male school children in Houston and Coffee Counties to ascertain the history and spleen index. Our aim was to determine the practicability of the measure to be used by all of our county health officers in locating the areas of malaria infection in their counties, if any. The results were as follows:

	Houston	Coffee
Boys examined	193	1747
Positive malaria history	80	1[illegible]8
Enlarged spleens	3	83
Positive history rate	40.81%	10.19
Positive spleen rate	19 %	4.75

The survey showed that the distribution was not a general one. In Coffee County there were three areas which surrounded mill ponds which produced *A. quadrimaculatus* in abundance. These ponds are now controlled. The distribution in Houston County is along the southern and eastern borders where the county is flat and effective drainage is beyond any economic possibility. An educational program to encourage screening is to be carried out. The time consumed in making these surveys was not excessive and could be carried out in conjunction with school examinations in all counties.

Summary of Projects under Permit

Number of impounded water areas		69
Number of counties in which areas are located		24
Number of areas before 1923	5	
Number of areas in 1923	8	
Number of areas in 1924	8	
Number of areas in 1925	20	
Number of areas in 1926	18	
Number of areas (to date) 1927	15	
Total number of acres in areas		85,361

List of Impounded Areas before 1923 and not under Permit

Mitchell Dam 1921	5500 acres
Cantt Dam 1921	2100 acres
Newton Dam 1922	240 acres
Lock 12 1914	6500 acres
Muscle Shoals 1917	20000 acres

Summary of Malaria Work as Reported by Counties (Organized)

	Beginning of Season	Increase during Season	Decrease during Season	Total at End of Season
Known endemic foci in county	64	5	7	62
No. of these surveyed	49			
No. of foci eliminated				8
No. of foci partially controlled				22
No. of old foci under maintenance				41
Population protected				220,500
Cost of control (labor and material)				$87,513.61

Ditching

New ditching 39,932 yards	$9,050.96
Old ditching cleared and maintained	193,800
Oiling of Foci	60,000 gals.
Total cost about	$29,000.00

Local Mosquito Measures were carried on in:

1. Birmingham	8. Fairhope
2. Cloverdale, Montgomery	9. Bay Minette
3. Mobile	10. Anniston
4. Selma	11. Jacksonville
5. Demopolis	12. Piedmont
6. Dothan	13. Opelika
7. Foley	

MALARIA CONTROL IN ARKANSAS (1927)*

By M. Z. BAIR†
Little Rock, Ark.

We have filed a statistical report showing that in Arkansas we have had an increase in the number of cities undertaking malaria control work. There are 35 cities incorporated that are doing the work, 25 under our direct supervision, that is, the communities are visited regularly during the season and the work checked and those locally in charge advised. Twenty-one of these communities have spent something over $71,000 and we feel our per capita cost is too low for best results.

We have under observation one impounded area which, generally speaking, has been in excellent condition. There is only one point on the area which has produced mosquitoes and this is not of sanitary significance due to the fact that there are no habitations in close proximity. Two other impounded areas are up for consideration now and will probably be studied within the next year.

Rural work has not taken on any extensive development in Arkansas. There will probably be a great stimulus to this class of work resulting from the screening which was so excellently done under Mr. LePrince's and Mr. Tarbett's direction and also as a result of the great increase in full time county health units which we are experiencing in Arkansas. We feel certain that rural work will soon develop and grow rapidly.

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*Report to National Malaria Committee, Conference on Malaria, meeting conjointly with Southern Medical Association, Twenty-First Annual Meeting, Memphis, Tenn., November 14-17, 1927.

†Chief Sanitary Engineer, State Board of Health.

MALARIA CONTROL IN FLORIDA (1927)*

By B L Arms M D †
Jacksonville Fla

Very little interest in this subject has been displayed by communities and counties having malaria problems The main activity along mosquito control lines was in localities having practically no malaria problem With return of normal conditions to Florida the malaria problem has again resumed its natural habitat namely in the area north and west of the Suwannee River and East of the Apalachicola River a continuation of the limestone sink area in Georgia Daytona Beach reports that the anti mosquito campaign there, carried on by the Health Department as a routine procedure have wiped out dengue and malaria fevers Perry the county seat of one of the most heavily infected malaria counties in the state has continued its maintenance work after the anti malaria drainage program put over by the State Board of Health and city and lumber interests some years ago Reports from officials and citizens there are that the work is very valuable The city of Perry has a compulsory screening ordinance and it is enforced No other city in the malaria section has shown any great activity Public interest in malaria has been aroused in many small centers through activity of the Florida Federation of Women s Clubs which has had the problem presented to its members through moving pictures talks and reports The State Chairman of Public Health has adopted mosquito control as her program for two years

The State Board of Health can offer no financial aid to any community doing malaria work No other agency is offering aid The only full time county health department under medical direction has been doing excellent educational work along this line

A comprehensive malaria survey about an impounded area of 15 000 acres was made before clearing was started or water impounded Smears were taken adult mosquitoes caught and identified and local breeding places observed Out of about 800 thin smears only one positive was found and out of 395 thick smears some two months later eighteen positives were found The histories of malaria of all persons within a mile of the new shore line were taken

*R port to National Malaria Committee (Conf renc on Malaria) me ting conjointly with Southern Medical As oc ation Twenty First Annual Me ting Memphis Tenne se November 14 17 19?7

†State Health Officer

MALARIA CONTROL IN KENTUCKY*

By A T McCormack M D,†
Louisville, Ky

At Herrington Lake, in the Dix River Dam section all of this year there has been almost an entire absence of anopheles breeding Culex breeding continued It seems that the vegetation along the edges of the lake have been cleaned out very considerably by the fishermen and the boats There is no malaria

Our flood in Kentucky came a long time before there was any particular flood elsewhere and we did not do much about it in the early stage In the flooded area we had a very considerable increase in anopheles breeding and about 100 per cent increase in reported malaria cases From the interior rivers the Green River and Cumberland and other water sheds there was a considerable increase in malaria because many ponds and sloughs had filled that had been dry during the drought in several of the counties

Concerning the flood situation we did not realize there was as much water in those counties as there was In the area of the Mississippi itself there has not been so much increase because we used quinin prophylaxis in the beginning There has been considerable swamp drainage work done most of it toward the end of the season

But we have had an increase of 100 per cent in our reported cases Of course that is not accurate but the increase in reported cases is considerable food for thought In 1923 we had 2 300 reported cases of malaria They were in the neighborhood of 1800 last year This year there have already been a few more than 3800 cases reported on the morbidity charts of physicians

One of the difficulties we had at the time we were starting our screening operations in Hickman County was a ruling from the Red Cross that the tenants themselves had to make the request through the local committee for the screens Of course that meant that we could not screen at all because these tenants were out in the mud planting cotton and the screening operations were very much delayed there We succeeded in getting some mosquito bars and they were of considerable assistance in that par

*Rep t to National Malaria Committ e (Confe ence on Mala ia) meeting conj intly with Southern Medical A ciation Twenty Fi t Annual Me ting Memphis T nne Nov mb 14 17 19 7

†State Health Officer

ticular area. That is the only county in which we had the least increase in malaria incidence in the flooded section.

I believe that was a mistaken policy. If the plantation owners could have made the requisition for the screens we should have had the entire area screened. We shall have it screened anyhow, but it will take longer to do it.

MALARIA CONTROL 1927 AND 1928 IN GEORGIA*

By L. M. Clarkson,†
Atlanta, Ga.

Our malaria control for the current year has consisted in rendering service to municipalities for eradication of both the pestiferous mosquito and the anopheline, especially the anopheline in sections of high malaria infection.

Engineering surveys and estimates have been made for drainage projects affecting both urban and rural communities. One major drainage project is now under way. This is a dredging project and will require two years for completion. This is a malaria control project of prime importance. Several other such projects are being promoted.

Regulations are being enforced for malaria control measures on hydro-electric impounded areas. There are approximately thirty-five such impounded areas. All of these have either been cleared or are in the process of clearing. On several of these areas oil is being applied during the breeding season and on one throughout the year.

The expansion of control operations since last year is chiefly on problems of impounded water. Clearing of proposed impounded areas and others previously impounded and application of certain oil mixtures and cost data on same are outstanding.

Control of artificial impounded waters by clearing and oiling and elimination of natural impounded waters by drainage are expected to be the outstanding activities for the coming year.

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*Presented to National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association, Twenty-First Annual Meeting, Memphis, Tenn., November 14-17, 1927.

†Chief Engineer, State Board of Health.

MALARIA CONTROL OPERATIONS IN MISSISSIPPI (1927)*

By Felix J. Underwood, M.D.,†
Jackson, Miss.

The following data in circular form were sent to those concerned during the month of February and in general as intended indicate the conditions existing at the beginning of the year.

To Directors of County Health Units:

It is thought that the following information pertaining to the general condition in this State regarding malarial fever may be of interest to you and serve to aid your plans for 1927.

In 1924 there were 79,631 cases of malarial fever reported for the State. In 1925 the number of cases reported totaled 71,950—a material reduction.

In 1926, 71,871 cases were reported—only 79 less than the preceding year.

For the first time in six years total cases of malarial fever reported during the third quarter have exceeded the number reported for a like period during the preceding year.

In 1925, of 11,630 blood specimens examined 14.61 per cent were found to be positive.

In 1926, of 10,491 specimens examined 14.23 per cent were found to be positive.

In the 14 Delta counties malaria showed an increase of 1.25 per cent in 1926 over 1925.

Of total cases of all diseases reported 33.4 per cent were in the Delta, while 46.2 per cent of the malaria was in that section.

For the State from June to November inclusive there was an increase of 3,538 cases of malaria.

As these months represent the principal malaria transmission period of the year it is indicated that the disease actually increased in 1926 and that a large number of infections will be carried over into 1927.

A map showing the density of malaria by counties throughout the state in 1926 was recently mailed to you.

In 1925 the departure from normal of rainfall was minus 5.06 inches. In 1926 it was plus .05 inches, there being over 7 inches more rainfall in 1926 than in 1925.

There were 11 more rainy days in 1926 than in 1925 and the periods of rainfall were more suitable for continuous anopheline production during the malaria transmission months.

Temperatures were slightly more favorable in 1926 for warm weather activities of mosquitoes which were vastly more numerous than for several years.

If the present weather conditions continue without killing frosts and freezing an early crop of *Anopheles quadrimaculatus* may be expected. Earlier more severe and increased malaria may be the result.

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*Presented to National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association, Twenty-First Annual Meeting, Memphis, Tennessee, November 14-17, 1927.

†State Health Officer.

Information similar to the foregoing can be furnished for most of the counties

Sincerely yours
George Parker Director
Malaria Control

For the first nine months of 1927 the departure from normal of rainfall was minus 0 34 inches, while there was a deficiency of 3 40 inches for the corresponding period of 1926 *There were therefore, 3 06 inches more rainfall* for the period this year than in 1926

There were ten more rainy days this year January through September than for the same period of 1926 The periods of rainfall were in general equally suitable for continuous anopheline production during the two periods

Temperatures were more favorable in 1927 than in 1926 from February to August for warm weather activities of mosquitoes

In April 1927 the mean monthly temperature was 5 degrees above normal Unseasonably warm periods occurred near the beginning of the month and about April 28 with heavy frosts in the north and central counties about April 23 Except in the overflowed district farming operations made fair to good progress, generally

In April *1926* the mean monthly temperature was 3 degrees below normal being deficient at all stations having an established normal The month was unusually cool with frost on the first Vegetation in general was unseasonably belated and soil abnormally cold Considerable cotton and corn planted early in the month failed to *germinate promptly and much replanting* was necessary At the close of the month farm work was about two weeks later than the usual average This condition in general maintained until about May 15

The warning issued and prediction made in February is reasonably substantiated by the *preceding data for April 1927 and April 1926*

Before entering upon that section of the report giving activities the following data is presented which indicates the general trend malarial fever has taken throughout the state so far this year, from January 1 to September 30

There has been an increase in malaria of 18 7 per cent for the entire *state*

This increase occurred in 57 or 69 5 per cent of the 82 counties and ranged from 0 8 per cent to 128 9 per cent

In the remaining 25 or 30 5 per cent of the counties, malaria decreased from 1 5 per cent to 41 7 per cent

Thirteen of the 14 Delta counties show increases ranging from 0 8 to 58 3 per cent, the remaining Delta county showing a decrease of 30 4 per cent It was completely inundated during the flood

Of the ten counties in the flooded area 4 of *which were completely inundated 9 show* increases ranging from 0 [illegible] to 58 3 per cent

The average increase in the 14 Delta counties was 17 3 per cent

The average increase in the counties in the flooded area was 12 9 per cent

The average increase in the Delta counties not in the flooded area was 28 4 per cent

The average increase for the counties not in the Delta was 32 5 per cent

The average increase for the counties not in the flooded area was 32 2 per cent

Should malarial fever be compared with typhoid fever, using the *1926* data which *is* complete on both deaths and cases for both diseases, the following would be noted

During that year there were 2 613 cases of typhoid with 390 deaths, and 71 871 cases of malaria with 409 deaths

The deaths from typhoid were 14 9 per cent of the total cases reported and from malaria 0 6 per cent

According to acceptable data it is found that in Mississippi considering *deaths only there* were 185 250 days lost from typhoid fever in 1926 and 1 227 000 days lost from malarial fever An economic loss of but one dollar per day represents a tremendous price paid in one year from either disease particularly malaria

Assuming the 2 000 000 population are housed in *400 000 buildings sanitary excreta disposed* will cost at least $4 000 000 00 in laying a permanent foundation for typhoid control

In 1926, Mississippi had 78 counties with a malaria rate in excess of 10 per 1000 If $5 000 00 were available and intelligently expended annually as an average for each of these *counties in ten years $3 900,000 00 would* have been expended, and the state would be practically free of malaria

These figures are relative and results depend on organization While the figure quoted for malaria control can be reduced fully 50 per cent, the relation is given to indicate what the result might be if malaria control were to be given the consideration and made as intensively a part of health programs as is typhoid control This is thought to be worthy of the consideration of *the National Malaria Committee*

During the season special malaria and mosquito control campaigns receiving supervisory aid from the central office were conducted in municipalities having a total population of 80 000

About the beginning of the malarial season April 21 the Mississippi River levee broke in Bolivar County resulting in the complete flooding of four counties and partial flooding of six counties all being located in the heaviest malarial section of the State

During the entire season activities of malaria personnel at the central office were almost completely confined to this section of the State

Aid from the Red Cross made possible the distribution of thousands of mosquito bars quinin and oil in abundance Further aid from the Red Cross on a screening campaign advised by the U S Public Health Service resulted in the screening of windows and doors on 3 276 houses with 171 houses yet to be finished

The malaria situation in Mississippi requires a *larger organization operating out of the central office* The study of the individual or county problem and the working out of a program basically the same for all counties in the state is decidedly important and can be best handled through the central office

There is not in the State of Mississippi any problem in malaria control that can not be effectively dealt with by following a reasonable and low cost *program making the control* of this disease a part of the regular program of full time county health departments in counties having a malaria problem of sanitary importance

The tendency of the desire of the people of this state is toward general mosquito control and to be able to follow up such a lead will hasten the control of mosquito borne diseases

MALARIA CONTROL IN SOUTH CAROLINA*

By JAMES A HAYNE M D †
Columbia S C

In the latter part of 1926 numerous complaints of mosquito prevalence in various towns caused the inauguration of surveys for community mosquito control Twenty five towns were visited in which complete surveys were made maps prepared and reports submitted to the *health authorities outlining specific control measures* for each town necessary to eradicate mosquito breeding

About 25 per cent of the towns adopted the recommendations made and good results were apparent in these towns . The towns not adopting our recommendations are at present requesting help in mosquito control

A pamphlet was compiled giving complete instructions as to mosquito control for communities and these were distributed very generally throughout the State This pamphlet embodied complete control measures a mosquito ordinance and a weed ordinance The control measures outlined in the pamphlet with the addition of the ordinances have proved entirely effective wherever adopted

Arrangements having been made with Clemson College the University of South Carolina and the Citadel lectures were delivered in March to the senior class in engineering at these colleges emphasizing the relation and importance of en*gineering work in malaria control* As a result of these lectures this work will be undertaken each year as requested by the college authorities In addition to the above lectures a pamphlet was compiled and mailed to all practicing engineers in the State and those outside the State practicing in this State requesting their cooperation along the lines indicated in the pamphlet

The Highway Department was requested to cooperate with the State Board of Health along these lines and their work during the past year has proved satisfactory and efficient borrow pits having been drained culvert pipes being correctly located and other control measures such as oiling having been carried out in a satisfactory manner

The definite development of a dam on the Saluda River about ten miles above Columbia impounded a lake of 45 square miles for hydroelectric development . Negotiations were entered into with the Lexington Water Power Company in which they agreed to finance a malaria census survey of the territory adjoining the lake The International Health Board agreed to cooperate with the State Board of Health in this survey and an exhaustive survey was made during the summer months consisting of a field force in

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*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty First Annual Meeting Memphis, Tennessee November 14 17 1927

†State Health Office

charge of Mr L T Coggeshall of the International Health Board assisted by two medical students and an engineer, resulting in the examination of 4 365 persons with a complete malaria history of each person recorded A map was prepared and blood smears taken It is proposed to continue the investigation in the vicinity of this lake during the next four or five years requiring the necessary control measures to be taken to prevent an increase in malaria prevalence in this section

Through the cooperation of the United States Public Health Service the United States Navy and the citizens of Bamberg an experiment in aeroplane dusting with Paris green over a densely wooded pond was carried out successfully

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MALARIA CONTROL IN TENNESSEE*

By E L Bishop M D,†
Nashville, Tenn

The malaria control problems in Tennessee lie principally in the western part of the State between the Tennessee and Mississippi Rivers This is an area some 100 miles wide and 100 miles long

Five counties in West Tennessee did county malaria control work in 1927 They are Shelby, Obion Lake Dyer and Lauderdale Control in the latter three counties was made more difficult by the flooding of large areas of land by the backwaters from the recent Mississippi River flood

Surveys were made by the flooded counties, including all of the towns therein and recommendations made for proper control The National Red Cross supplied oil one tank car and 131 barrels for use in the three flooded counties The distribution of the oil and general malaria control was under the direct supervision of the local full time county health departments In tensive quinin prophylaxis was used in these counties

The National Red Cross provided some $5300 for the screening of homes in the flooded area in Tennessee A screen door factory under the supervision of the United States Public Health Service was installed at Dyersburg and 1400 screen doors were made The doors were made by the local high school class in vocational training The doors were put up as well as the screening of the windows under the supervision of the County Health Units A total of 956 homes were reported as screened Eight of these were in Shelby County

Shelby County started malaria control in 1923 in cooperation with assistance and money from the State Department of Public Health Shelby County did anopheles control over 130 square miles of territory in 1927 This area was largely around the City of Memphis but many of the smaller communities out in the County did good work Fifty thousand gallons of oil were used, all of which was waste oil from filling stations Twenty five pounds of Paris green mixed with 100 parts of dust were used for mosquito control in the river bottoms For culex control, ten barrels of disinfectant were used one gallon of disinfectant being added to fifty gallons of oil Private individuals spent about $5000 on ditching and the County did a mile of ditching

In 1924 25 Shelby County stocked 1500 ponds with *Gambusia affinis* The ponds were observed in 1927 and the minnows are in large numbers where there are no large fish

County malaria work in Obion County has been principally along Reelfoot Lake where educational work and many posters were put up regarding malaria control and the advisability of screening and prophylaxis

The following cities and towns in Tennessee did mosquito control work this year Memphis Covington Ripley, Halls Gates Dyersburg Union City Franklin Tiptonville Ridgely, Martin, Trenton Humboldt, Milan Cookeville Brownsville Dresden Jackson Cowan Murfreesboro and Chattanooga Many smaller communities also did malaria control work The Division of Sanitary Engineering made original surveys for control and re-inspections in the majority of the cities

Impounded water mosquito control problems

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*Report to National Mala ia Committ e (Conferenc on Malaria) *meet ng* conjointly with Southern Medical Association Twenty First Annual Meeting Memphis Tenn ssee November 14 17 19 7

†Commis ioner Department of Public Health State of Tennessee

continued to grow in importance in Tennessee in 1927 Falling Water River Dam owned by the City of Cookeville had very good mosquito control this year Control was effected by clear ing oiling and regulating the pond level with flash boards on the crest of the dam

The Tennessee Electric Power Company about completed the clearing of its reservoir at Rock Island This reservoir has one hundred and twenty five miles of shore line Additional sur veys for control will be made next year

The accompanying table shows that there has been a gradual decrease in the death rate for malaria in the principal counties in West Ten nessee and a more rapid decline in the counties that have health units This probably is due to the general idea that is being disseminated on malaria control, better information to the prac ticing physician and to the public and a very extensive road building campaign while on the other hand in the counties that have full time county health departments we have been getting better reporting of malaria and in the meantime have been confirming diagnosis by blood smears which in a way will eliminate cases that were once diagnosed as malaria

MALARIA DEATH RATE BY COUNTIES 19 0 26 IN CLUSIVE (FIVE YEARS)

Counties	1921	1922	19 3	[illegible] 4	1925
Shelby	45	62 9	33 7	26 6	23 5
Gib on	36 6	25 1	27 3	9 1	24 3
Obion	56 4	17 6	42 3	42 2	35 2
Lak	43 8	65 4	23 4	43 8	21 6
Tipton	9 2	75 5	3 7	26 1	45 6
Lauderdale	10 1	83 4	78 6	18 5	16 2
Weakley	23 9	19 3	16 1	12 9	3 2
Dyer	5 1	76 2	65 2	22 6	16
Haywood	23 6	19 7	11 2	31 5	23 6
Fayette	34 7	[illegible] 1	18 2	18 7	31 7

Shelby County death rat (averag 1915 to 1922) ——— 61 8
Sh lby County death rate (averag 1922 to 19 5) ——— 41 3
Malaria co trol started [illegible] 3

Gibson County death rate (verage 1915 t 192.) ——— 36 7
Gibs n County d ath rate (average [illegible] to 19 5) ——— 21 6
H alth Unit tarted 192

Obion County death rate (av rage 1915 to 192) ——— 43.7
Obl n County death rate (average 1922 to 19 5) ——— 39 9
Wo k started 19 3

MALARIA CONTROL ACTIVITIES IN TEXAS RESUME FOR 1927*

By J C ANDERSON M D †
Austin Tex

	Malaria Case Reported	Deaths r ported
1924	16 068	141
19 5	11 502	[illegible]
19 6	13 728	139
19 7	8 971	133‡

No of counties reporting malaria ——— 98
No of towns carrying on mosquito control w k in some way ——— 106

The amount appropriated for control activities by the cities and by the State was a little less than in former years Several drainage projects were completed by the Reclamation Department which will minimize mosquito propagation to some extent in the areas drained Minnows were distributed in some of the irrigated districts

Educational articles were submitted to the press and pamphlets and folders on mosquito control were sent to quite a number of schools Local inspectors received training on methods of mos-quito eradication at our short school The Cotton Belt Railway Company continued its anti mosquito program in a number of towns along its line

Plans were perfected to have the Missouri Pa cific run an educational train over its lines car rying an exhibit car illustrating mosquito con trol measures (This train was run in January and February, 1928)

*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty Fi t A nu l Meeting Memphis T e s e Nov mbe 14 17 19 7

†State Health Officer

‡For ten months

MALARIA CONTROL ACTIVITIES IN VIRGINIA*

By H [illegible] GRANT M.D †
Richmond Va

In 1927 the malaria activities in Virginia con sisted in educational work carried out in nine counties in which there were no organized county health departments and study and con

*R port to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medi cal As ociation Tw nty First Ann l M ti g, M m phis, Tennessee, November 14 17 1927

†Director of Malaria Co trol, State Board of H alth.

trol work conducted by the health officers in most of the organized counties in Tidewater Virginia The educational work consisted in the distribution of literature on malaria control in the unorganized counties through the school children

In Accomac County the health officer has made a re survey of the various ponds and has given special attention to the districts of Chincoteague and Tinney s Pond These two places have been the only two in which quadrimaculatus breeding was found this year In Northampton County a re survey of the county has been carried out Several additional ponds have been discovered which were breeding quadrimaculatus The town of Cape Charles has had this year over twenty cases of malaria The breeding places which were responsible for this malaria have been determined and control measures projected

The combined unit of Norfolk and Princess Anne Counties which began this year is conducting a survey of both counties In neither one of these counties is malaria a major problem At the town of Virginia Beach in the county of Princess Anne, control of anopheline breeding by dusting with Paris green has been carried out successfully during the season

In Nansemond County the studies of previous years have been kept up both at Lake Prince and at Lake Cohoon At Lake Prince we are still controlling anopheline breeding by cleaning and fluctuation In Lake Cohoon breeding was this year controlled by the draining of the upper portions of the Lake Beginning June 27 six feet of water were drained from this Lake this removed the water from the upper reaches of the Lake and as a consequence breeding ceased for the rest of the season Control has been also carried out in Nansemond County at Pinner's Pond the overflow of Lake Kilby, the Atlantic Coast Line Pond and at the Kingsboro Pond In these last two ponds control was effected by dusting with a mixture of Paris green and road dust This method of control was effective

In Brunswick and Isle of Wight Counties our malaria program has been interrupted by the changing of health officers Malaria is no longer a problem in Brunswick County but in Isle of Wight it constitutes the major problem Murphy s Mill Pond and Carrollton Pond are to be drained this autumn

The re survey of Henrico County has revealed many more ponds than those previously studied Malaria however, is not a problem of any great importance in this county, there being a few cases discovered on the outskirts of the City of Richmond

Southampton County which was just organized this year is making a survey for the first year s work Special attention has been given to the towns of Boykins Branchville Franklin and Courtland

In addition to our malaria work a study of the pest mosquito has been carried out throughout this section this year

The following year we hope to further our rural malaria work by the organizing of new counties Urban malaria is no longer a problem in Virginia

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CONTROL OF MALARIA IN THE CITY OF MEMPHIS*

By J A LEPRINCE †
Memphis Tenn

Since cotton was first grown in the market area of our City we have been importing malaria cases and until the present health administration took hold very little had been done to stop malaria transmission within the city limits

For ten years before malaria prevention activities were undertaken the malaria death rate averaged 80 per 100 000 and in the seven years of anti malaria activity the average malaria death rate was 20 a reduction of 75 per cent What is this work costing the average tax payer

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*Clinic Clinic Session Southern Medical Association Twenty First Annual Meeting Memphis Tennessee November 14 17 1927

†Senior Sanitary Engineer U S Public Health Service

THE IMPORTANCE OF PLANTATION MALARIA TO MEMPHIS AND THE PLANTATION OWNER*

By H A JOHNSON †
Memphis, Tenn

The farming area immediately about Memphis is mainly of the so called Delta plantation type During the labor shortage that exists on plantations at crop gathering time large numbers of cotton pickers are recruited in Memphis for work in the field This labor in the Delta at a time when malaria is at the peak of its prevalence there, has abundant opportunity to become infected and to bring malaria back to the City There is little doubt that much of the malaria seen in Memphis originates in this manner

Notwithstanding the fact that a great deal of agitation is now being directed to diversifying southern farming operations, cotton will continue to be the main crop in the flat Delta lands where 'plantation farming is practiced

Malaria is of vital importance to the plantation owner, because a larger part of the disease is confined to his area and because the disease strikes his labor at picking time when labor is always scarce

In manufacturing industries every effort is made to keep labor fit The profits of industry depend on the efficiency of labor and we find that industrial establishments maintain hospital, welfare, and relief departments just to insure well and contented employes They find it pays

Plantation farming can be likened to a specialized form of industrial establishment The cost of operating the plantation is made up among other things of fertilizer, seeds, implements, mules, and labor Labor, however, is approximately 50 per cent of the production cost We find the plantation owner studying methods, best use of implements, rotation of crops, markets, soforth Why does he refuse to become interested in the one item that is 50 per cent of the total cost of production, labor?

Malaria strikes another definite blow at the plantation owner s profits At the time when labor is scarcest, and cotton prices are highest, that is at the beginning of the harvesting time, malaria is at its peak The direct result is that harvesting is delayed cotton is damaged by the weather and a much lower average price is received for the year s crop

If the plantation farmer is going to prosper he must come to realize as manufacturing establishments have done, the potential profits that are his if he devotes interest and energy to making labor efficient

A definite increase in the price received for the year s crop can be realized by malaria elimination, and other work devoted to keeping labor fit, and when the unnecessary expenses have been eliminated the plantation owner is going to find himself in a better position to meet the necessary obligations of his business and the spread of malaria by his labor to the cities adjacent the Delta areas will cease to be of importance

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*Clinic Clinic Session Southern Medical Association Twenty First Annual Meeting Memphis Tennessee November 14 17 1927

†Technical Assistant in Sanitary Engineering U S Public Health Service.

SYMPOSIUM ON MALARIA

Papers and Reports Presented at the Conference of
the National Malaria Committee, Meeting
Conjointly with the Southern Medical
Association at Asheville, North
Carolina, November
12 15, 1928

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SYMPOSIUM ON MALARIA

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THE CONTROL OF MALARIA AS A PART OF FULL-TIME COUNTY HEALTH DEPARTMENT PROGRAM*

By FELIX J. UNDERWOOD, M.D.,
Jackson, Miss.

In this day of health promotion all health workers are unquestionably of the opinion that the full time county health department is the most logical source through which disease control on a large and efficient scale can be established and maintained. If this is the consensus of opinion, and I truly trust it is, then every effort should be made to bring all forces to bear in the establishing of a full time county health department in each county of every state in the Union.

Under the control of the local full time health department should therefore come the handling of every health problem in the territory, including malarial fever.

It is not believed that a worth while malaria control program can be successfully carried on without full time personnel, even with an organized county health department upon a permanent basis. Unless a well trained, energetic, practical, tactful health officer directs and promotes the work, assisted by an active, intelligent, interested sanitary inspector, with necessary cooperation from the state health department with a good division of malaria control, very little will be accomplished and the people will continue to be disappointed with the results obtained. An expert malaria epidemiologist with the assistance of one or more highly trained experienced sanitary engineers seems necessary if anything approaching adequate state wide supervision of malaria control activities in states having a real problem is to be honestly and intelligently undertaken.

We find doubting Thomases among health workers, physicians and laymen all over the Country for the reason that as a rule our past efforts have been spasmodic in nature with untrained, inappreciative and uninterested personnel. Another discouraging factor in our program has been that some of the engineers have thought that no one else could possibly know anything worth while about malaria control and some medical malaria epidemiologists have seemed to think that it was largely their peculiar problem and that the engineers were self seeking, self promoting usurpers in the field.

We all now recognize, or should recognize, that malaria control is a problem for cooperation and sustained effort and that foolish petty jealousies should be forever banished. We must not forget to be practical as well as scientific.

It is recognized that where malaria is of sanitary importance it presents a large and difficult problem, and aid from the state health department is essential to determine the most effective program of control.

It is not profitable nor is it wise to make hasty surveys depending on morbidity data and information picked up at random upon which to base control operations. Such methods result in a large waste of time and money and are certain to produce dissatisfaction among the local populace should inadequate control result therefrom, which can hardly otherwise be expected, and to place in jeopardy the security of the health unit.

We here face the fact of organization within the county, a factor to which perhaps too little attention has been given in the past, and the class of personnel comprising the force of the department. Unless the personnel has had the basic training and realizes the importance of practical application in the field, and unless there is an intimate knowledge of the people and their surrounding economic and social conditions, little if anything can be effectively done towards controlling malarial fever.

It is known that malaria is rarely, if ever, evenly distributed through a district in this Country. Even in extremely malarious sections spots are to be found where there is little or no malarial fever. The lack of proper knowledge of the problem, where it centers, and a definite and practical program for its control will more than probably turn the supposed milestones of progress into tombstones of disaster.

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*Chairman's Address, Section on Malaria, Committee [illegible] (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Second Annual Meeting, Asheville, North Carolina, November [illegible] 1928.

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*Chairman's Address, Section on Malaria [illegible] Southern Medical Association Twenty-Second Annual Meeting [illegible] November 12-15 1928

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A quick and reliable guide or measurement of the problem is, therefore essential Districting of the county according to existing or supposed facts is a first consideration, to be followed by the measurement of the problem in the districts selected

In some places physicians morbidity reports are available but rarely do the e reports indicate the location of the patients nor are all the existing cases of malaria seen by physicians These reports furnish an indefinite guide at best

To attempt the taking and examination of blood is a long tedious and expensive procedure the result being wholly in the hands of the examining technicians This with the lack of confidence in results obtained from examination of but the one blood specimen from the individual makes the procedure questionable for use in quickly determining whether or not in a given area there exists a malaria problem of sufficient magnitude to spend time and money upon

The examination of spleens is limited to a relative few often perhaps to that group not so seriously affected as those of advanced ages or other races This also requires considerable time is not reasonably reliable and is costly

The indirect or proxy interview to obtain malaria histories affords only a questionable result as does the direct interview when conducted by untrained personnel or well informed personnel lacking that understanding of the peculiarities or psychology of the classes of people to be dealt with

For our problem in this Country we have no adequate measure and too often we find prevailing the riding of hobbies both for measurement and control operations and conflicting opinions prevailing when only the one subject is in question

We must get down to the practical procedure being as sure of our ground as present knowledge permits and have the It Can Be Done confidence

But in whom can confidence be placed other than in trained personnel and by trained personnel is meant not the sixty day sanitary inspector nor the new health officer or sanitary engineer or nurse but that singular group of health workers who have not only the basic training but that indefinable public health viewpoint and a sufficient knowledge of economics and sociology peculiar to the territory involved

Malaria control is a business undertaking and a well organized county health department is or should be a business institution

This disease, as was said, is not evenly spread over any given county territory and consequently sectional problems must be treated as existing evidence of malaria warrants, necessitating a flexible program with a basic standard

Malaria control as part of a full time county health department program is not only feasible but practical, and while this subject has been chosen for discussion, the writer is at a loss to comprehend why, so often, it is not considered and why, when it presents an outstanding problem health officers absolutely neglect to give it the consideration it warrants Gradually the standard of health personnel is being improved With the type of workers now entering the field rests not only the practical control of malaria but the handling of other problems as well

Time is of extreme value to all health officers and to determine the extent of a malaria problem time is an element of importance

The surest, most practical the least costly and the most reliable quick method for determining whether or not a malaria problem of importance exists within a given area is the taking of direct histories Only one proviso is made to this statement which is that the worker know his subject as well as his subjects and be sufficiently interested to withstand the monotonous grind associated with the work

After establishing the fact that problems do exist in various localities the dealing with the individuals by taking blood specimens to foster treatment can be undertaken

These statements are made advisedly, as only recently a history index of 402 persons in a certain section of Mississippi gave a rate of 17 2 while the blood index gave a positive rate of 17 2 While exact agreement of the two rates will seldom occur yet the evidence is there and past experience has demonstrated the reliability of the measure

The difference between malaria control and malaria investigation must be recognized, as must anopheline control versus general mosquito control and it must be continually borne in mind that the result is what is desired even though several years must be spent even to pave the way

The results to be achieved probably never will be spectacular It may require many months of effort to determine the distribution and extent of malaria in a county After this determination only a very few foci may be brought entirely under control during the next one or two years but if the program is followed consistently and consecutively over a period of

years as a part of the general public health program of the county health department it is believed that the same good results will be achieved as in typhoid control the consolidation of rural schools construction of permanent public highways etc bearing in mind that it is only over a period of years and by being everlastingly at it that satisfactory progress is made along all lines of human endeavor

Control measures should not and cannot be discussed here as they will vary according to the problems presented and the advisability of their application and are preferably worked in combination

To prevent new cases and cure existing cases is the object

First must come educational work for to act intelligently one must understand

Permanent eradication is to be desired which means anopheles control This is not always practical and leads to the application of such methods as will reasonably solve the problem

The individual acting as an individual or a plantation owner or head of a large concern employing labor in a malarious section is as much responsible for the control of malarial fever as for typhoid diphtheria smallpox or any other communicable disease and therewith rests the *practicability of malaria control as part of the* county health department program

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A RESUME OF STUDIES UPON PLASMOCHIN*

By WILLIAM KRAUSS M D †
Memphis Tenn

At the 1927 meeting of this Conference I reported my experience with plasmochin in the treatment of 108 cases of malarial fever Owing to the short time intervening between the conclusion of the work and the presentation of the study the material had not been fully digested and many important observations had not been brought out

It is the purpose of this contribution to make further observations upon these cases as well as upon 27 cases observed in 1928 and present some conclusions as to the advantages and disadvantages of plasmochin as a remedy for malaria It was found and reported that plasmochin was a satisfactory remedy for the treatment of infections with *Plasmodium* [illegible] *vax* but that it could not be relied upon for the treatment of estivo autumnal malaria We found that gametes of *P* [illegible] *vax* disintegrated and disappeared at about the same rate as the schizonts In the case of *P falciparum* we noted disappointing *results in the control of the vegetative phase* but a very decided effect upon the gametes which however was less pronounced than upon *P* [illegible] *vax*

To recapitulate the findings in the 1927 se[illegible]ries in the cases of tertian malaria the maximum time recorded for the disappearance was six days for schizonts and five days for gametes In the majority of cases the blood was free from both after four days

In the cases of estivo autumnal infections schizonts persisted as long as eight days with plain plasmochin the gametes persisting in one case eight days with plain plasmochin plus quinin and nine days with plasmochin compound None of the 1928 series exceeded these limits

As to the contribution of quinin to these results some comment will be presented further on

These findings are in entire accord with those appearing in many reports in the *[illegible]rch f Schiffs u Tropen Hygiene* and elsewhere which can be studied in abstracts appearing in *Tropical Diseases Bulletin* 1925 *et seq*

Considerable difference of opinion exists as to what may be considered a safe dose of plasmochin under *all circumstances*

To make clear the conditions under which cyanosis has appeared in our cases in 1927 as well as in 1928 the mode and frequency of administration must be considered Although some of our cases were treated with plasmochin alone in others quinin was added later or combined in the beginning In the tables presented last year[1] patients receiving both drugs apparently responded more slowly that when either was given alone These patients did not get *quinin until it was deemed necessary to add it* because of the persistence of the fever or the parasites

When treated with plasmochin alone plasmodia persisted longer than the fever In the beginning there is a definite provocative effect so that parasites and especially gametes would be more abundant on the second day the drug acting like small doses of quinin in this respect. It must be understood that the stage of development of the parasites was taken into consideration

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Second Annual Meeting Asheville North Carolina Nov [illegible] 12 15 [illegible]

†Professor of Tropical Medicine University of Tennessee College of Medicine Memphis Tenn.

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The difference between malaria control and malaria investigation must be recognized as must anopheline control versus general mosquito control and it must be continually borne in mind that the result is what is desired even though several years must be spent even to pave the way

The results to be achieved probably never will be spectacular It may require many months of effort to determine the distribution and extent of malaria in a county After this determination only a very few foci may be brought entirely under control during the next one or two years but if the program is followed consistently and consecutively over a period of

years as a part of the general public health program of the county health department it is believed that the same good results will be achieved as in typhoid control the consolidation of rural schools construction of permanent public highways etc bearing in mind that it is only over a period of years and by being everlastingly at it that satisfactory progress is made along all lines of human endeavor

Control measures should not and cannot be discussed here as they will vary according to the problems presented and the advisability of their application and are preferably worked in combination

To prevent new cases and cure existing cases is the object

First must come educational work for to act intelligently one must understand

Permanent eradication is to be desired which means anopheles control This is not always practical and leads to the application of such method as will reasonably solve the problem

The individual acting as an individual or a plantation owner or head of a large concern employing labor in a malarious section is as much responsible for the control of malarial fever as for typhoid diphtheria smallpox or any other communicable disease and therewith rests the practicability of malaria control as part of the county health department program

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A RESUME OF STUDIES UPON PLASMOCHIN*

By William Krauss M D †
Memphis Tenn

At the 1927 meeting of this Conference I reported my experience with plasmochin in the treatment of 108 cases of malarial fever Owing to the short time intervening between the conclusion of the work and the presentation of the study the material had not been fully digested and many important observations had not been brought out

It is the purpose of this contribution to make further observations upon these cases as well as upon 27 cases observed in 1928 and present some conclusions as to the advantages and disadvantages of plasmochin as a remedy for malaria It was found and reported that plasmochin was a satisfactory remedy for the treatment of infections with *Plasmodium vivax* but that it could not be relied upon for the treatment of estivo autumnal malaria We found that gametes of *P vivax* disintegrated and disappeared at about the same rate as the schizonts In the case of *P falciparum* we noted disappointing results in the control of the vegetative phase but a very decided effect upon the gametes which however was less pronounced than upon *P vivax*

To recapitulate the findings in the 1927 series in the cases of tertian malaria the maximum time recorded for the disappearance was six days for schizonts and five days for gametes In the majority of cases the blood was free from both after four days

In the cases of estivo autumnal infections schizonts persisted as long as eight days with plain plasmochin the gametes persisting in one case eight days with plain plasmochin plus quinin and nine days with plasmochin compound None of the 1928 series exceeded these limits

As to the contribution of quinin to these results some comment will be presented further on

These findings are in entire accord with those appearing in many reports in the *Arch f Schiffs u Tropen Hygiene* and elsewhere which can be studied in abstracts appearing in *Tropical Diseases Bulletin* 1925 et seq

Considerable difference of opinion exists as to what may be considered a safe dose of plasmochin under all circumstances

To make clear the conditions under which cyanosis has appeared in our cases in 1927 as well as in 1928 the mode and frequency of administration must be considered Although some of our cases were treated with plasmochin alone in others quinin was added later or combined in the beginning In the tables presented last year[1] patients receiving both drugs apparently responded more slowly that when either was given alone These patients did not get quinin until it was deemed necessary to add it because of the persistence of the fever or the parasites

When treated with plasmochin alone plasmodia persisted longer than the fever In the beginning there is a definite provocative effect so that parasites and especially gametes would be more abundant on the second day the drug acting like small doses of quinin in this respect It must be understood that the stage of development of the parasites was taken into consideration

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*Read bef Nati n f Malaria C mmittee (Confer c n Malaria) m ting o jointly with So thern M dic l A o i ti n Tw ty S cond Annual Meeting A h ill North Carolina N v mb 12 16 19 8

†Pr f f T opical Medi in Uni e ity f Tennessee C ll ge of Medi ine Memphi T nn.

Taking advantage of this fact, we adopted the practice of beginning treatment with plain plasmochin if the clinical diagnosis was reasonably certain and checking this with a blood examination later This procedure gave us an early start on the gametes as patients frequently sign out in less than five days

If the blood showed *P falciparum* or if the fever persisted for three days we added quinin sulphate (10 gr t i d) There is quite a factor o error in the ring stage or in double infections which is not recognized until the complete fever curve has been recorded or the drug has failed Sometimes there was a relapse in a day or two and typical rings and crescents were seen

Plasmochin can indeed be relied upon for a correct differential diagnosis

Several deaths from plasmochin having been reported, I reviewed the histories of the patients receiving plasmochin treatment in my service

Of these 135 patients 108 were treated in 1927 Seven of these developed toxic symptoms of varying degrees In this series the maximum daily dose was five tablets of plain plasmochin, given singly after food equivalent to 0 1 gm

In the 1927 series of 108 patients we had

1 case of tertian after 38 tablets epigastric burning

1 case of tertian after 28 tablets cyanosis lasting 48 hours

1 case of tertian after 22 tablets cyanosis lasting three days

1 case of tertian after 27 tablets vomiting and severe epigastric pains

1 case of estivo autumnal after 30 tablets severe cyanosis depression lasting four days relapsed later

1 case of estivo autumnal after 31 pill of plasmochin comp pyrosis

1 case of tertian after 26 tablets marked cyanosis

In the series of twenty seven cases treated in 1928 the tablets (0 02) were given two at a dose three times a day Since we were on the look out for toxic symptoms this seemed to be a simpler technic Toxic symptoms resulted in five cases or 14 8 per cent This mode of administration is unsatisfactory

The series comprised three case of slight cyanosis following 36, 22 and 14 tablets of plain plasmochin, one case of marked cyanosis following 24 tablets and one of severe cyanosis lasting six days associated with vomiting which lasted three days following 20 tablets There were no toxic symptoms in others taking as much as 36, 38 and 42 tablets, respectively

None of the patients receiving quinin in addition to plasmochin showed any cyanosis although one of them had received fifty two tablets, or a total of 1 4 grams One of the 1927 series however, had also had some quinin

Although the symptoms in most of these cases were slight and transient, it is apparent that even five tablets daily given singly constitute too large a daily dose for general practice This will be discussed later

On account of many inquiries since the publication of my last paper some explanatory statements seem to be in order

Many physicians appear to believe that plasmochin is in every way superior to quinin and have wanted to prescribe it in pernicious malaria Some have disregarded the precautions insisted upon in the literature, and have observed severe toxic symptoms

The following points are emphasized

Plasmochin is useful and quite equal to quinin in ordinary doses in benign malaria It is the only remedy that definitely affects gametes

Plasmochin cannot and must not be relied upon in the treatment of estivo autumnal malaria Persistence in experimenting with plasmochin in estivo autumnal malaria will result in serious disappointment and possibly some deaths from pernicious malaria If crescents are present it should be given in conjunction with the quinin

Cases of malaria occurring prior to July 1 (in our latitude) are very rarely of the estivo autumnal variety

All cases of frank intermittents with short paroxysms may be treated with plasmochin

Plasmochin produces none of the objectionable symptoms of cinchonism and should be preferred in cases of quinin idiosyncrasy if the blood unequivocally shows only tertian parasites These patients were delighted at the total absence of the usual symptoms of cinchonism

Regardless of whether quinin is needed for the control of the fever only plasmochin can affect gametes and thus prevent transmission

On account of the very great variation of susceptibility, plasmochin prescriptions should bear the legend Nil repetantur ' in large type or red ink and patients should remain under daily observation If this cannot be done the remedy should not be prescribed

How can plasmochin be used in public health practice?

Fischer and Weise[2] emphasize the toxicity of plain plasmochin and recommend that only the compound be given in doses of not more than

three dragees per day. This dose is quite insufficient for the cure of the fever because these contain only 0.01 gram of plasmochin but Fischer and Weise insist that quinin should be given in addition to prevent the reappearance of gametes.

I think this is excessive caution admitting that several deaths have been reported following persistence in the exhibition of large doses.

Brosius[3] who has been the largest user of plasmochin, employs only the compound pill adding more quinin if the symptoms do not come under control promptly. He says he has never seen any toxic symptoms from six of these daily, or two pills three times a day. He agrees with many other observers that quinin is synergistic as a plasmodicide but inhibits the toxic effects of the drug.

It has been abundantly shown by others as well as in our service last year and with 17 cases treated exclusively with plasmochin this year that for the benign malarias we have a complete substitute for quinin. We have the additional even more conclusive evidence that gametes of both species rarely resist plasmochin longer than five days if it is given in full (5 tablets) doses that is 0.1 gm. daily in single doses of 0.02 gm.

Unfortunately our relapse experience has not been bettered.

Just to show how little we have advanced in eighty years in the methods of treating malaria with quinin and how little can be expected from it for the eradication of gametes I shall quote some old malaria literature.

Sobernheim (1840) quoting Griesinger writes[4]

> The total dose of quinin to be administered in quotidian and tertian fevers is according to Gittermann's results compiled from several thousands of observations 12 to 16 gr. (0.72 to 0.96 gm.) but in quartan fever 20 gr. (1.2 gm.)

Coming down to the period following Laveran's discovery we read:

> The statements of Golgi (1884) regarding the effect of quinin in cases of fever accompanied with crescent forms the developmental cycle of which was not yet known to him are much less distinct. He emphasizes that these forms, similar to the lasting forms of schizonts are almost insusceptible to the action of the ordinary agents. The infection had not disappeared in many cases after 10 to 12 grams of quinin given in the course of eight to ten days although the attacks of fever failed to appear.
>
> Regarding the flagellated forms which in his time were not identified with crescents Golgi was not able to determine an influence of quinin either upon the occurrence of these forms or upon the manner in which they presented themselves or upon their movements.
>
> Guido Baccelli injected neutral solutions of quinin hydrochlorate (quinin hydrochlorate 1.0 sodium chlorid 0.75 distilled water 10.0) into the veins of numerous malaria patients, especially in severe pernicious forms of the disease in which the other modes of absorption had proven to be insufficient and he found that doses of 10 to 30 centigrams were entirely insufficient that doses of 40 to 60 centigrams showed a better effect which were not completely satisfactory that doses of one gram however which corresponded about to the concentration of one to 5,000 determined as fatal to infusoria by Binz had infallible therapeutic effect.
>
> The pigmented and crescent shaped varieties of Laveran remained visible for several days after the intravenous introduction of the quinin and after the disappearance of the fever ... the developed forms the semilunar and pigmented ones occurred also during the afebrile intermission in such a manner that the condition of the blood in these various forms proved to be identical in patients suffering from quinin poisoning and in those that were not affected by the latter.
>
> Mannaberg[6] 1892 after describing changes in fresh blood at different stages after the administration of quinin says:
>
> One form of malarial parasite is totally resistant to quinin namely the crescent.
>
> It is the unanimous statement of all observers that crescents remain unchanged after the most persistent administration of quinin and that the therapy is incapable of playing even a prophylactic role in that relapses occur whether or not quinin is exhibited in the apyretic interval.

Numerous other observations in accord with what has been quoted can be found in the voluminous classical literature of the period and not a single authority is in conflict with them.[7]

The very extensive literature upon the war experiences with malaria has not modified these observations with respect to the effect of quinin upon crescents or for the prevention of relapses.

It is hardly necessary to allude to the studies of Yorke and McFie[8] and those of James and Shute[9] with respect to the prophylactic value of quinin. Sir Malcolm Watson on the ground of his very extensive experience in the Federated Malay states says that where the blood index is 50 per cent quinin is not effective.

Just what the systematic use of plasmochin would accomplish in the way of temporarily preventing transmission from convalescents can be determined only by its extensive use by many field workers through several seasons.

For this purpose the compound pill containing 0.01 gram plasmochin and 0.125 gram quinin sulphate should be given according to the directions supplied by the manufacturers. For relapsing patients this dose must be reinforced by concurrent doses of quinin not less than 15 grams per day in the same interrupted manner.

Manson Bahr[10] proposes to give plasmochin compound for a full week in three courses with

five day intervals This permits complete elimination of the drug between courses His impression is that relapses have been greatly diminished

The German plan of five day treatments with only two-day intervals may not be entirely safe in general practice, if full doses are given

We may then consider four lines of treatment

(1) The one employed by the author begin with plain plasmochin, one tablet five times a day, after food adding quinin as outlined in this paper but not in solution Suspend plasmochin after five days or at the appearance of cyanosis Plasmochin compound one tablet three times a day, may be safely substituted, but the treatment must continue longer before crescents will be found absent from thick films Repeat plasmochin if the crescents persist

This treatment requires two daily visits or an alert house staff It insures prompt destruction of gametes Follow up treatment is necessary to prevent relapses

(2) The ambulant plan sponsored by the Medical Service of the United Fruit Company the dose is two tablets of plasmochin compound three times a day together with full doses of quinin sulphate for five days, then report for blood examination Ninety six per cent of their cases were free from crescents Follow up treatment is given according to indications

(3) For public health survey work according to Fischer and Weise three tablets plasmochin compound with full doses of quinin are given for a week After an interval of two to five days the course is repeated Quinin is given to prevent relapses

(4) Manson Bahr s treatment was quoted above

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DISCUSSION (*Abstract*)

Dr I J Kligler New York N Y—After the first three to five days our chronic patients refused to take plasmochin because it had a provocative effect upon their symptoms There was no cyanosis, but there was, by blood examination a definite stimulation of the malaria parasites in the patient and in one case hemoglobinuria resulted It should be recognized therefore that the drug has a provocative effect particularly in malignant malaria

For the time being one ought to limit the use of plasmochin to treatment under the control of a physician and not use it wholesale as a prophylactic

Dr R L Miller Waynesboro Ga—I have tried plasmochin in 163 cases and am most favorably impressed with the results

My plan has been to break up the acute attack with quinin and then put the patient on plasmochin compound In this way I have reduced decidedly the number of relapses. I used it in several families where one member of the family was the gametocyte carrier with no pecial effort to protect the other members of the family with no other development of malaria in the e families I have also used it in plantation work among negroes with happy results

Most of my laboratory work was unsatisfactory but of three cases in which gametes were found they disappeared in five days in one ca e six days in another and eight days in the other

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Dr M A Barber Greenwood Miss—I will describe briefly our work in Central America with plasmochin

We made blood parasite surveys of groups of West Indian negroes living on the plantations of the United Fruit Company Panama Division Positives were brought to the Company hospital where they were given a dose of plasmochin plus quinin by Dr Otto Brosius Superintendent of the Medical Department Panama Division They were given a supply of both drugs to take home with them

At the end of two days they returned for a further treatment and supply making in all three trips at intervals of two days At the end of the week we examined their blood to determine the percentage of positives

We also examined treated groups at various intervals after treatment to determine the percentage of relapses

We fed *Anopheles albimanus* on the blood of certain heavy gametocyte carriers after a hort treatment with plasmochin plus quinin It appeared that plasmochin may render gametocytes non viable while they are still plentiful in the peripheral blood

The series of experiments on gametocyte carriers was a short one and we plan to continue this work in Panama during the coming winter The purpose of the work is to determine more clo ely the minimum dose of plasmochin which will destroy gametocytes or render them non viable Such work may help to lay the basis for a wider use of the drug

Our results of la t winter are published in the Sixteenth Annual Report of the Medical Department of the United Fruit Company

SODIUM CACODYLATE IN THE TREATMENT OF PERNICIOUS MALARIA*†

By E. E. MURPHEY, M.D., F.A.C.P.
Augusta, Ga.

Those of us who live in a highly malarious country or near enough to it to have the severer forms of malaria sent into our hospitals are frequently confronted with one of the real emergencies of the practice of internal medicine the comatose algid or asthenic type of estivo autumnal fever

The City of Augusta lies directly upon the fall line above it impounded waters below it cypress river swamps which stretch unbroken to the sea So that each year there come into our hospital wards in diminishing numbers happily many cases of severe malarial infection These cases are always desperately sick and the problem of what is to be done for them in the first twelve or twenty four hours is urgently pressing There is no time to be lost in the administration of drugs by mouth which may or may not be absorbed no time for a slow or cumulative drug effect to manifest itself Emergency measures only will meet the situation

Clinical experience taught our forbears the inefficiency of quinin medication alone in these cases and the literature of thirty or forty years ago is replete with articles and controversies anent its value With the subsequent development of intramuscular and intravenous quinin medication it was hoped that the objections advanced to quinin *per ore* would promptly disappear

This however did not prove to be the case quinin administered intramuscularly being attended by sterile but very painful and slow healing sloughs quinin intravenously by gravely toxic symptoms collapse and death the sum total of which is constantly increasing as the case reports accumulate

Having passed through several most unpleasant quinin tragedies the writer stimulated by an article by Laumonier[1] in 1906 began experimentally to use sodium cacodylate in the severer and more exigent types of malaria At first our medication was wary and tentative in doses of 1 5 to 2 grains intramuscularly two or three times daily with apparently beneficial results

With the rapidly increasing popularity of intravenous medication and the appearance on the market of the product in sterile ampoules a shift was made to the intravenous route which has been utilized in increasing doses for more than ten years The drug was used primarily as a substitute for quinin in cases where quinin was deemed to be contraindicated by reason of the slowness of its action by mouth or its danger intravenously As soon as possible the arsenic was discontinued and routine quinin treatment by mouth resumed

It was considered of sufficient interest to treat a considerable number of cases with sodium cacodylate alone in order that some estimate of its action unaided by quinin might be obtained

Increasing familiarity with the harmlessness of the drug led us by slow degrees to increase our doses to a point where now in pernicious cases we administer four doses of 7 5 grains each at six hour intervals until the patient has emerged from coma or in other ways shows such improvement that the routine quinin therapy may be resumed

In the purely experimental cases the dosage was halved as soon as the parasites disappeared from the peripheral blood which usually occurred on the third or fourth day and this dosage was continued for fourteen days

There seemed to those of us who followed these cases that there was no greater tendency to relapse or recrudescence after the arsenic was discontinued than is usual after the administration of quinin for a similar period

There have been very few reactions following this dosage which were worthy of note or comment occasional nausea and vomiting colicky pains the persistent ineradicable garlicky odor of the breath and a brassy taste being the chief symptoms of which the patients complain

In no case have we had any skin rashes or dermatitides such as are frequent after arsphenamine or stovarsol

The following brief histories from the record of cases studied in the University Hospital are presented for your consideration

Case 1—Ida L a Jewish housewife age 23 was admitted September 24 19[illegible] She had become ill four days before admission with chill high fever intense nausea and vomiting She was unable to retain any nourishment and very little water Just before admission her temperature was 97 F On admission it was 100 F rising shortly to 104 Blood showed a very heavy infestation with estivo autumnal ring forms

Sodium cacodylate 5 grains was administered intravenously every six hours for three days after which the dose was halved

*Read in Section on Medicine Southern Medical Association Twenty Second Annual Meeting Asheville North Carolina November 12 15 1928

†From the Department of Medicine University of Georgia.

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The series of experiments on gametocyte carriers was a short one and we plan to continue this work in Panama during the coming winter The purpose of the work is to determine more closely the minimum dose of plasmochin which will destroy gametocytes or render them non viable Such work may help to lay the basis for a wider use of the drug

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jections after intervals of two or three days and while it is not justifiable to draw any conclusions from this phenomenon it is to our minds at least sufficiently suggestive to induce us to offer it here for discussion and for subsequent confirmation or refutation by interested observers

One is impelled to wonder if there be not some peculiar inflexibility about the 'medical mind If we could for a little while remove from our consciousness our belief in the specificity of quinin we could perhaps evaluate more fairly the use of arsenic in the malarial fevers

Certainly when in experimental therapy we seek an etiotropic agent for use in protozoan infections we turn almost uniformly to some of the pentavalent forms of arsenic and yet in this particular protozoan infection we treat a valuable therapeutic agent with less consideration than is normally shown to be a backward stepchild

The very history of medicine teaches us that arsenic and its derivatives were believed to be useful in paludism from time immemorial nay more were the acknowledged specific until the time when the Jesuit Fathers brought back the first cinchona bark from Peru so that in continuing over a considerable period of years a study of the effect of arsenic in the severer forms of malaria the writer can lay no claim to originality but only to the persistent unremitting attention to the action of this particular drug It must not be understood that the use of arsenic in this form could be expected to replace many other therapeutic measures which are indicated its role being that of a safe non irritating and dependable etiotropic agent for use in the frequent emergencies which arise in the treatment of malaria

(1) It is the belief of the writer that sodium cacodylate in proper dosage will clear the blood stream of malarial parasites and cause a cessation of all symptoms

(2) A sufficient number of cases has been studied in which arsenic alone was used to convince the writer that it will by itself permanently cure malarial fever

(3) It is not germane to this discussion whether it acts directly upon the parasite or merely by stimulating phagocytosis

(4) To attain the results described 20 to 30 grains should be administered in each twenty four hours

(5) It is less toxic when administered intravenously than is quinin is more efficient than arsphenamine and less apt to produce a rash than is stovarsol

(6) It is becoming increasingly apparent that quinin therapy alone is not the solution of the cure of malaria and a further study of the action of the arsenicals together with that of iron must be made before the problems which confront us will be solved

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DISCUSSION (*Abstract*)

Dr J B McElroy Memphis Tenn—I believe that there is only one use of intravenous injection of quinin and that is in the comatose cases I have seen no distress or disagreeable results from it but that is possibly because I did not use it except when it was very strongly indicated I believe it will be advantageous to us to follow Dr Murphey's suggestion

Dr S Chaille Jamison New Orleans La —I have had no experience with the use of sodium cacodylate intravenously in the treatment of acute malaria I did advocate many years ago in a paper published in the SOUTHERN MEDICAL JOURNAL the use of cacodylate of soda in cases of malaria that had developed very severe anemia and I attributed much of its value merely to its effect upon the anemia

I have had the experience in the negro wards of the Charity Hospital of seeing patients who were under intravenous arsphenamin treatment for syphilis actually develop chills and fever That shocked my faith in the power of the arsenicals in the treatment of the disease very seriously I must confess

We have used quinin intravenously since 1910 at the Charity Hospital. It is now becoming a rare thing in New Orleans to use this treatment We teach that quinin is not to be used intravenously if the patient can take it by mouth and that so far as any of us who are connected with the staff knows it has no value intramuscularly *When the patient becomes comatose he* has to be given the quinin intravenously never more than 15 grains to the dose and never stronger than a 1 per cent solution either in freshly distilled water or saline We have had no accident that we can attribute to the quinin I do not believe that quinin is at all dangerous in the treatment of pernicious malaria

If while you are giving a certain treatment plasmodia disappear *from the blood, it is not proof that* the disease is cured. Any of us who has lived in a malarial country have had the very bitter experience of seeing a patient die from malarial fever which was not demonstrated until autopsy the blood smears having been negative We have always felt that if a patient had malarial fever and was in coma we could usually find enormous numbers of plasmodia in the blood. Dr Castellani told me at one time that it was not at all necessary for plasmodia to be demonstrated in the blood stream even if the patient were comatose from malaria I confess that was new to me

We now have in New Orleans scarcely enough cases of malaria to demonstrate to our classes.

Dr R L Miller Waynesboro Ga.—I have noticed that those patients who pass the time for the next exacerbation without coming out of coma almost invariably die This shows the utter futility of temporizing *with any drug that is slow of action or dependent*

Paroxsyms recurred September 27 her temperature reaching 103 F There were paroxsyms on September 29 and October 1 with a maximum temperature of 102 F

The blood was negative September [redacted] the fourth day after beginning treatment and it remained so thereafter No quinin was used.

Case 2—Thomas D a white farmer age 28 was admitted August 20 1919 with a history of pronounced idiosyncrasy to quinin He had been ill for three weeks before admission He was having daily *chills with high* temperature anorexia emaciation and dehydration Temperature on admission was 105 F and he was semi comatose Pulse was 140 and respirations 20

Abundant estivo autumnal ring forms were found

Sodium cacodylate 5 grains was administered every six hours His blood remained positive through August 21 and was negative thereafter (two days positive)

On August 21 his temperature rose to 104 in the *afternoon with a morning decline to 99 For three* days an identical rise occurred after which it declined to normal and remained there throughout his convalescence

The dosage was halved on the fifth day No quinin was administered and there was no recurrence

Case 3—R A T a *white insurance agent* age 50 was admitted August 2 1922 in coma with temperature of 105 4 pulse 130 and respirations 28 Estivo autumnal rings were found

Sodium cacodylate 7 grains every four hours for three doses was given Next day the patient was mentally clear Sodium cacodylate was given at 5 00 and 8 00 p m His maximum temperature the second day was 102 Quinin treatment was instituted the third day The blood was negative He had an uneventful recovery

Case 4—S P a male rabbi age 59 was admitted November 15 1920 He had been ill for six days before admission with chills and fever recurring daily His skin was cold and clammy expression pinched pulse small and wiry temperature 97 F pulse 120 and respirations 26 The blood showed a heavy infestation of estivo autumnal ring forms

Sodium cacodylate 5 grains was administered every six hours for three days halved daily for the remainder of his stay in the Hospital

Paroxysms ceased November 21 and the temperature remained normal No quinin was administered throughout this case and there was no recurrence

Case 5—P L a well nourished and developed white farmer aged 39 was admitted September 20 1928 a stretcher case comatose His temperature was 106 25 blood pressure 100/60 and pulse 112

Sodium cacodylate 15 grains was given September 21 and 22 He regained consciousness on September 21 and gave a history of previous good health to September 14 on which day he developed a chill and high *temperature*

Paroxysms were repeated September 16 and 18

Quinin therapy was resumed September 23

The blood was negative for estivo autumnal parasites from September 24 to 27 Gametocytes were present September 28

Case 6—This experimental case was seen July 7 1919 A negro man a speak easy bartender aged 42 had a history of a daily chill and high temperature for five days The temperature was 105.35 pulse 120, full and bounding and he had severe head and back ache

The blood showed a heavy infection with two broods of tertian parasites

Sodium cacodylate 7.5 grains was administered every six hours for two days There was a paroxysm on July 8 and an abortive paroxysm on July 9 The temperature was normal thereafter The blood was negative July 10 and medication was discontinued He had a recurrence July 14 the day after treatment was discontinued

These histories are presented as being typical of a series running well into the hundreds, and are condensed to show only one salient point, the reaction of the individual to the particular medication under discussion

Year after year our students and our house staff men after the conclusion of their terms of service in the University have returned to the hinterland to engage in the practice of their profession, and from them there have come continuously reports that they have been carrying out the methods of treatment outlined above *with satisfactory results*

It has seemed that the action of this particular drug is somewhat less efficient in benign tertian forms of malaria than in the estivo-autumnal cases there being in a number of experimental cases of tertian fever an apparently greater tendency to recrudescence or relapse

I trust that it will not be assumed that I am advocating the abolition of quinin therapy but in view of the experience which I have had the definite conclusion has been reached that we have in sodium cacodylate an agent which is capable of at least temporarily arresting the *progress of the disease* and that in cases where, for purposes of observation no quinin was used, a permanent cure seemed to have been effected

We have come to believe that in small doses we are able to induce provocatory stimulation somewhat similar to that occurring in spirochetal infections In several cases where the question of the diagnosis of malaria was pressing and where the most careful repeated examinations of films and thick smears failed to reveal the presence of parasites the administration of five to seven grains of cacodylate followed by examination of the blood at two hour intervals for ten hours revealed the presence of sexual forms in the peripheral blood In several other cases afebrile but presenting symptoms suggestive of chronic malaria the injection of a provocative dose as above described was followed by a rise of temperature but without demonstrable parasites in the blood stream which rise of temperature would follow several successive in

DIFFERENCES IN THE HABITS OF ANOPHELINES WHICH TRANSMIT MALARIA IN AMERICA, IN EUROPE AND IN THE FAR EAST*

By L W HACKETT MD
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Doctor Darling whose personality and fund of experience we miss with poignant regret on such an occasion as this used to say that to become a good malariologist one had to learn to think like a mosquito. Each malaria worker of course devotes himself to the psychoanalysis of the particular species with which he has to deal and constructs his program accordingly. He does not often have the opportunity to work in a number of different regions of the world and so he thinks of malaria constantly in terms of his own particular problem. He falls into a sort of provincialism as necessary and pardonable as that of the poet who sang What is so rare as a day in June? forgetting for the moment that it was midwinter below the equator.

But is is now getting to be known that all anophelines everywhere do not think alike by any means and the specialist in one mosquito must be on his guard against what Darwin called the most hazardous of human tendencies the drawing of general conclusions from limited experience. Scientific literature now reaches an international audience and what is said here today with local conditions in mind will be read tomorrow in Italy India and Peking. Our soundest knowledge then may lead us astray if we enter unwarily into discussions with foreign workers or recklessly publish unqualified generalizations and theories with regard to mosquito behavior and control or worst of all if we reason by analogy and take the lessons we have learned through hard work or bitter experience in one region and attempt without preliminary study to apply them in another. This has been done of course time after time before the medical entomologist was developed and could obtain the ear of the responsible authorities. For if failure or disaster occurred in these cases it was almost always due to the unexpected behavior of some Anopheles mosquito.

One of the most famous examples may be found in the story of the sanitation of Kuala Lumpur capital of the Federated Malay States. After long and painful experience rubber planters on the coastal plains had found that clearing the jungle for half a mile round about the laborers quarters protected them from malaria since *A umbrosus* the carrier required dense shade in which to rear its larvae. The same thing therefore was done about the inland town of Kuala Lumpur but with precisely the opposite effect plunging the whole anti malaria effort into confusion and discouragement. Malaria increased tremendously and was a heavy burden for nine years until in 1916 Strickland an epidemiological entomologist proved to the satisfaction of the authorities that they had to do with quite another anopheline (*A maculatus*) of habits and inclinations diametrically opposed to those of *A umbrosus* preferring sunlight to shade and running water to jungle pools. In fact *umbrosus* was never found at all in Kuala Lumpur and nevertheless the ranges of the two mosquitoes were not ten miles apart. Ignorance of the distribution of *umbrosus* says Sir Malcolm Watson[1] cost the Country much money and many lives.

A similar entomological situation exists in certain regions of Italy where *maculipennis* the principal malaria carrier will not breed in brackish water. Schemes have been evolved and in certain cases successfully carried out for letting the sea into fresh lagoons and low lying marshes to stop anopheline breeding. The old pre Ross belief which held that the admixture of salt water to fresh increased the malaria was discarded as unscientific. Recently however La Face has revealed a hitherto unsuspected fact that in great submerged areas near the mouth of the Po *maculipennis* is replaced by *elutus* a mosquito very similar in appearance but different in species an excellent malaria vector possessing the ability to breed in salt water. Thus some basis was afforded to an ancient belief and empiricism in mosquito control brought again into well merited discredit.

America has had such experiences in its tropical possessions. It was found in Panama that the *bromelia* a parasitic plant growing on the limbs of trees and holding a quantity of water in its cup like heart was widely distributed and was breeding anophelines. In some countries it has been considered a cause of malaria. The project was discussed of seeking out and destroying all these plants. It is probable that Darling saved the Panama Canal hundreds of thousands of dollars by proving in time that no malaria-carrying mosquito was being produced

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Second Annual Meeting, Asheville, North Carolina, November 12-15, 1928.

upon a cumulative effect In the commercial world there is a phase Time is the essence of the con tract So in dealing with the comatose form of ma laria time is of the utmost importance In fact it is the determining factor We must select a drug whose therapeutic effect can be rapidly obtained without ne cessitating a long wait upon gastric absorption

In mercury we have a specific possibly more effective in syphilis than quinin is in malaria Likewise in yaws trypanosomiasis and the other protozoan infections we turn immediately to some form of the arsenicals If it is efficient in these protozoan infections one is cer tainly within the bounds of good therapy in using it in malaria

I do not use quinin intravenously for the reasons outlined by Dr Murphey I have been using cacodylate of soda for the past six or seven years with the same happy results which Dr Murphey has obtained

Dr William Krauss Memphis Tenn—I have had no experience with sodium cacodylate in this dosage in the treatment of any disease In the treatment of estivo autumnal fever I have utterly failed with all remedies other than quinin I think the German writers all of the British writers and in fact in all the Tropics the same results have been reported We may say in a general way that there is no other disease except syphilis in which every promising remedy has been completely tried out In the tertian malarias all ar senicals are rather inferior to quinin for the suppres ion of the fever but they are not without value Of course Dr Murphey has achieved brilliant results and he has used a drug that none of us would have at tempted to use in such large doses certainly not intra venously I cannot make myself feel that it would be entirely safe It may be that the history of the treat ment of pernicious malaria will have to be rewritten in the face of this very bold therapy that Dr Mur phey has undertaken but at pre ent I still hold with the other malaria workers that the arsenicals are vastly inferior to quinin in the treatment of malaria arsphen amin stovarsol and sodium cacodylate not excepted

Dr J S McLester Birmingham Ala—I think arsenic is of limited value in the treatment of malaria We should be careful in drawing final conclusions from a small percentage of cases particularly as the patient with malaria will often get better if he is merely put to bed

The combined experience of the past has indicated that no drug is comparable to quinin for the treatment of malaria As for the preparations of arsenic used I cannot help but feel that Fowler s solution given by mouth is about as good as cacodylate of soda There is something impre sive in putting a drug in a pa tient s veins and we often feel that we are thereby em ploying energetic measures but it should be borne in mind that great harm can be done by injudicious intra venous therapy

Dr V P Sydenstricker Augusta Ga—My reaction to cacodylate of soda was at first just like that of the other speakers. It seemed rather u eless and perhaps irrational in the face of the wide pread efforts at ar senical therapy Going at the thing with an open mind or rather standing on the ide line with an open mind for about five years and then having used it to a very considerable extent for the past four years I am con vinced that not for the routine treatment of mala ria but for the treatment of the comatose patient who is vomiting and who is dehydrated and cannot absorb quinin by mouth and will not stand probably as much as 5 grains of quinin intravenously cacodylate is safe and is life saving It is not a substitute for quinin and Dr Murphey does not intend to imply that, but a patient who has been in coma for six or eight hours or who falls on the street in malarial coma reacts nicely to cacodylate and I think if it is used within the first eighteen or twenty four hours he will get well. Of course as soon as the immediate symptoms sub ide regular quinin therapy is instituted I have watched Dr Murphey s work with much interest I came to it with not only skepticism but rather an unpleasant re action but I have ab olutely changed my mind

Dr Cabot Lull Birmingham Ala—I wish to ask Dr Murphey what dilution of quinin was used? A case that I saw received 15 grains of fairly dilute quinin in travenously The patient was *in extremis* and after forty eight hours died I have always felt that the death was due to the type of the infection and not to the quinin since it occurred long after the injection

Dr M L Graves Houston Tex—In the fall of 1915 I had the opportunity to see many cases of malaria that we thought had been brought to Galveston on steamers from Mexico These were tertian and estivo autumnal infections I gave them rather large injec tions of sodium cacodylate in 3 5 and 7 5 grain doses After considerable experience with it I decided that it was not of sufficient value to continue its application in estivo autumnal cases

In one very serious case of estivo autumnal malaria I believe the patient s life was aved by a citrated blood transfusion 600 c c with 15 grains of quinin sulphate in the transfused blood

Dr Murphey (closing)—We have much malaria in our section of the world and to me it has always been a particularly fascinating subject of study

The dosage which we have used I will admit seems incredibly large but do not for a moment imagine that when I started this particular line of investigation my efforts were not as I have described them wary and tentative There seemed to be just enough encourage ment in the matter to go ahead, follow it further and see what results might be obtained I do not believe that I am taking the attitude of a Don Quixote tilting at the windmills of quinin therapy I am not bringing to you the untried enthusiasm of youth but the sea soned experience of twenty years Because I realized that this particular problem would need observation over a long period and accumulation of case history upon case history before any sort of conclusion could be accepted I have withheld anything but discursory papers until now because the twenty years were needed before I could believe that I was justified in my opin ion

The quin n fatalities mentioned occurred in the wards of the Ho pital when I was in charge They did not occur under my hands but my house staff was u ing the ordinary ampoule as it comes from the manufactur ing chemist The last of these three fatalities occurred ten years ago Death was practically instantaneous and certainly attr butable to quinin in the opinion of all of us

barbirostris neither of which is concerned with malaria transmission while of *culicifacies* or *listoni* the real malefactors we saw not a trace Some sort of trap must be employed such as a defective bed net In Malaya *A maculatus* disappears completely in the daytime and though a tiny and fragile insect, subjects itself to the perils of wind and weather rather than lie up in a man made shelter In the Philippines attempts to inculpate *A minimus* by dissection of specimens caught in Nature have failed through lack of material In seven days spent in the Islands I did not catch a single one although a sporting colleague offered as high as a peso apiece for adult specimens At the same time the larvae were abundant Now malaria is rife in all these places and it is evident the anophelines can keep it going although if they enter houses at all they remain only long enough to bite

I may mention also the theory that major drainage operations (referred to in Europe as great or integral bonification) have a direct effect on malaria by reducing the number of anophelines This is an American theory and it is undoubtedly sound for whether the water is put underground or not, the drainage of swamp or ponds and the putting the water into motion in canals streams or ditches in America is sufficient usually to abate the *quadrimaculatus* Even when streams are turned into ponds for power purposes though there may be at first a period of great *quadrimaculatus* production after four or five years in some mysterious way the waters become unattractive to the mosquito and the lake can be ignored It eems to resume the character of a river

Now in Europe the *maculipennis* breeds in the edges of moving waters as well as in ponds This is probably a temperature reaction since it often abandons still water if it becomes too warm But the result is that the draining of great plains and deltas such as that of the Po and the Tiber with the construction of ditches intersecting channels and great collecting canals does not greatly diminish the number of *maculipennis* As Grassi remarked, you have merely transformed an irregular swamp into a rectilinear swamp and mosquito production goes on as before Yet in some cases malaria has begun to disappear after these works, whereas in others it has remained the same or actually increased on account of the increase in population which follows Hence the European malariologist, doubtful about the relationship between the number of mosquitoes and the intensity of malaria, is driven to utter aphorisms such as "malaria flees before the plow" or (as Cavour said) that beefsteak is the best cure for malaria or (with Marchoux) that it often seems that the intensity of malaria is in inverse proportion to the number of anophelines Certainly a profound skepticism reigns in Europe today about the practibility of American ideas of eradicating malaria through mosquito control and in part this has arisen from the difference in breeding habits between the principal European and the principal American anopheline

I have cited these three theories which concern the causes of the spontaneous disappearance of malaria the importance of the few females resting in bedrooms and the effect of major drainage on malaria because they are subjects of present discussion and they seem to turn in each case on the behavior of a particular anopheline and yet they are often discussed refuted or defended in literature and conference as though they had general validity Certainly international contacts and exchanges are of great importance in the science of malariology if such it can be termed In many cases differences between malariologists may thus be resolved pacifically into differences between mosquitoes

But if the anophelines which transmit malaria have such diverse habits and characteristics all over the world it nevertheless occurs to us that there must be some profound similarity which makes of them all malaria carriers The comparative study of them ought surely to reveal why it is that one species is a carrier and another is not Such a generalization would be extremely useful to all malariologists everywhere

Such comparative studies however bring us upon the very puzzling fact that not only do anopheline species differ one from another but the same anopheline appears to behave differently in different situations Take the well known case of *A aconitus* Winoto (1919) found it infected in Western Java to the extent of 7 per cent while in the same year Swellengrebel in Sumatra dissected over a thousand specimens at the height of an epidemic and found none positive[4] We may ask whether it is certain these were really the same mosquito varieties or strains. For example two strains have been fairly well distinguished in the species *A ludlowi* one of which breeds in fresh hill streams, the other in salty mangrove swamps within reach of the highest tides. Now *ludlowi* is another one of those anophelines which carry

by the bromelias of Panama, and that they could be ignored

In the Philippines our occupying troops were faced with the problem of selecting without delay a healthy location for a large permanent military station On the basis of the best American experience and of local opinion it was placed in the hills at a considerable distance from the coastal swamps and marshy plains Unfortunately subsequent experience and careful surveys have shown that *A minimus* the principal malaria carrier in the Philippine islands breeds only in foothill streams and nowhere on the plains, while *ludowi* the mosquito of the coastal mangrove swamps so dangerous in Singapore, is quite innocuous around Manila Bay The camp had, therefore been located in the exact center of the most malarious zone of the Island

Such examples, however of action based on false premises through ignorance of the differences in behavior of anophelines are drawn mainly from the past Present day opinion on this subject is crystallized in one of the principal conclusions approved at the recent international conference of malariologists in Geneva in June of this year Each government is urged to create a small body of trained research workers in malaria spending all their time in scientific investigation and acting as advisers to the health authorities in the control of malaria Collaboration between such bodies all over the world coordinated possibly by some such agency as the Health Section of the League of Nations would permit the organization of programs of international investigation of certain questions at present unanswerable and might throw light on some of the theories which now seem to divide the malariological opinion of the world into something like opposing schools of belief

I would like to illustrate the importance of the international viewpoint by referring to one or two such theories now being actively discussed

A group of very well known European malariologists now holds in substance that malaria is an anomaly in a civilized country it is a typical concomitant of abandoned or under developed lands and primitive conditions where poverty and ignorance chiefly characterize society In their opinion malaria will tend to disappear automatically in the presence of intensive cultivation and improved standards of living Endemic malaria is thus not so much a medical or entomological problem as a social and economic one, and hence it is to the last degree futile to set about attacking the mosquito while these problems remain unsolved The progress of civilization, aided by a liberal distribution of quinin, will cause malaria to melt away like snow, even though the anophelines remain undiminished in number

Now, I think it can be sustained that this *spontaneous* disappearance of malaria in long established and heavily infected communities where *no measures at all* have been consciously taken against Anopheles, is a phenomenon to be observed *only in* temperate climates, and is possibly limited to Europe Certainly it is never seen in the tropics, where nevertheless numerous areas of intensive cultivation and considerable prosperity *are to be found* Here a reasonable protection from malaria is obtained only at *great labor and expense*, and no one would maintain for a moment that elaborate agricultural development and a high standard of living would by themselves keep malaria permanently out of the community were the Anopheles allowed to remain Recent studies of Missiroli and myself[3] point to the fact that "anophelism without malaria" is linked up with the food habits of the European anopheline *A maculipennis*, which in certain regions no longer bites man This is supported by the fact that the introduction of malaria carriers into these regions no longer gives rise to secondary cases of malaria

Another theory recently proposed both in England and Brazil is that most of the malaria is being transmitted by a relatively few house loving, well protected long lived and lazy female anophelines, and that the great bulk of the anopheline population is practically not concerned at all in the spread of the disease Hence house catching of resting anophelines has been exalted to an important place in methods of malaria control and generally recommended Whatever the validity of this theory in regions where anophelines remain in houses after biting it can have no reference to the major malaria problem of the Far East where it seems almost to be a rule of etiquette for the mosquito to leave the room immediately after meals I have myself been guilty of criticising a survey of the anophelines of Ceylon made by H F Carter the Government entomologist on the ground that the relative densities of species were based on larva counts rather than adult catches I had no idea until I visited the Far East how difficult it is to lay hands on the adults of most of the principal malaria carriers In Ceylon, a night's work in houses and stables and around tethered animals out of doors on a highly malarious cocoanut estate yielded a few *rossii* and

that entomology in the service of epidemiology is a fundamental necessity in the study and control of malaria

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DISCUSSION (*Abstract*)

Dr I J Kligler New York N Y —It is certainly true that the great point of dissension between malariologists is due to the fact that we have limited our sphere of activity rather too closely and have been thinking more of malaria and less of the mosquito We have assumed that the only consideration is the human and that the mosquito is not an entity worth worrying about

I am not familiar with conditions where one mosquito in 400 bites man most Anopheles I am familiar with bite man too frequently for our comfort and pleasure James maintains that infected Anopheles stay in the houses when they become infected

It so happens that the mosquito we have in Palestine *A elutus* resembles the *maculipennis* existing in Europe and England For the last year and a half we have examined the infected mosquitoes in houses and tables throughout the various seasons of the year and found a very peculiar condition We found that *elutus* and *superpictus* behave very differently In fected *elutus* live more consistently in houses et they change their habits they stay in houses during June to September but a large part of the infected mosquitoes pass out of doors during the period from September to January

A superpictus does not even behave during the summer as does the *A elutus* Some are found in houses and some in stables during the summer as well as in the winter

Various species of *Anopheles* in different parts of the world concerned with malaria differ markedly in their habits To base therefore a broad general action of the kind which may become one of the principles of the Malaria Commission of the League of Nations on the basis of experience or experiments with one species in one part of a country where malaria is not very prevalent is to say the least an unjustified procedure Such a generalization would affect harmfully the attempts of control of malaria in other parts of the world

I might cite a single instance of the danger of generalizations from local experience We have not had the experience of Dr Hackett where ditching a large flat marsh has brought about breeding of the same species of mosquito We have found a transformation in the fauna *El tus* is a marsh mosquito like the *maculipennis* Ninety five per cent of the Anopheles in an area were *el tus* Then the area was drained and very shortly after that the mosquito population *changed entirely* instead of 95 per cent *elutus* the prevailing species was *A superpictus* which prefers running to stagnant water The malaria problem was not solved by the drainage but control became easier Had we not been following the habits of the different mosquitoes we should have found ourselves face to face with a very serious situation as it was we were expecting this change and waited long enough for the change to take place and then took the necessary measures and averted a disaster or disappointment

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RECENT PROGRESS IN MALARIA ERADICATION*

By FREDERICK L HOFFMAN LL D †
Wellesley Hills Mass

My remarks on the present occasion cover a wide range of international efforts to reduce the incidence of malaria in some parts of the world to the vanishing point But the problem still remains an enormous difficulty demanding a concentration of qualified attention on the part of engineers entomologists physicians research workers and scientists generally Malaria is now, however infinitely less a mortality problem than a disease problem particularly in this Country during recent years Malaria as a disease also seriously affects many other and more important diseases hastening death in countless cases in which the organism has been weakened by continued attacks of malaria infection

My review covers some thirty different countries which it would be impossible to deal with even in the form of a very brief summary The address will therefore be printed together with the reprints of all my previous papers on malaria and made available to those who wish to pursue the subject further particularly from a statistical point of view

In the United States Registration Area the mortality from malaria has gone down from 3 8 per 100 000 in 1919 to 2 7 in 1927 but for the previous year the rate was only 1 9 so that the increase during the year is suggestive of the urgency of renewed efforts on the part of all concerned The most conclusive evidence of malaria reduction in this Country under adequate conditions of control is furnished by the United States Army The disease incidence has been reduced since 1902 from a rate of 201 2 per 1 000 military personnel to 6 7 in 1927 For white enlisted men the rate at Panama which

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*Read before National Malaria Committee (Conference on Malaria) meeting jointly with the Southern Medical Association Twenty Second Annual Meeting Asheville N C November 12 15 1928

†Consulting Statistician Prudential Insurance Company

malaria in one region and are harmless in an other But the ability to transmit malaria is not confined to one or the other strain and is apparently not linked up at all with the known bionomic differences The salt water variety is both the famous fever mosquito of the Javan and Malayan coasts and the perfectly harmless anopheline of the Manila fish ponds Sections of Batavia and Singapore are rendered almost uninhabitable through the malaria caused by this insect but in twenty years no authentic case of autocthonous malaria has been reported in Manila

The strange case of *bifurcatus* throws some light upon the subject In all parts of Europe it is a wild mosquito never found in houses but in Palestine alone it enters houses freely and is a most dangerous transmitter of malaria Is it then domesticity which makes carriers of mosquitoes and can this domesticity be acquired by an anopheline in one region and not in another? The answer is this cannot be the whole story for *A maculipennis* in Europe is a domestic mosquito wherever it is found but it is not always a malaria carrier Thus the map of malaria in Europe does not agree with the map of *maculipennis* distribution And yet *maculipennis* is with unimportant exceptions in *a few localities the only carrier in all this area* It is in Italy that the problem seems to be presented in its simplest terms Why in certain well-defined regions is *A maculipennis* a dangerous transmitter of malaria and why in other similar regions is it perfectly harmless even in great numbers and in the presence of gametocyte carriers? This has been the subject of numerous observations and experiments made during the past three years by Missiroli and myself at the Malaria Experiment Station in Italy We have come to the conclusion that in that country the amount of malaria in a community is the measure of the degree of contact between *A maculipennis* and man This varies greatly from region to region because this anopheline, though always domestic in habits bites both man and domestic *animals but in differing proportions* in different places Thus on the Tiber Delta one mosquito in four was taken in bed rooms (the highest rate we have yet observed marking a considerable degree of anthropophilism) in the Pontine Marshes this host index was one in nine in Massarosa (Tuscany) where malaria appears only as a sporadic case or two at long intervals (just as, let us say in New York State) the anophelines were plentiful but only one in four hundred of those captured had bitten man, as shown by the precipitin reaction of the ingested blood and in Val di Chiana, where malaria is unknown our party was unable in two different visits to find a single specimen containing human blood, nor were we able to be bitten at night, although we intentionally exposed ourselves and the anophelines were very numerous A very simple mathematical consideration will show that if only one in four hundred mosquitoes bites man it will take the square of four hundred, or one hundred and sixty thousand mosquitoes, to make sure that the same mosquito will bite two men a necessary condition for transmitting malaria The probabilities are further reduced by the chances of the mosquito s dying during the two weeks which must elapse before it can become infective and by the further chance that the first man bitten may not be a gametocyte carrier In short, though thousands of anophelines visit the precincts of each family in Massarosa every night in summer, it might take years to fulfill the conditions necessary for a single successful transmission of malaria even with the constant presence of a gametocyte carrier *Under* such conditions, endemic malaria cannot maintain itself, and we have the phenomenon known as 'anophelism without malaria The possi*bility is not of course excluded that* the same phenomenon if it exists in other regions of the world may have different causes

What instinct or circumstance it is which induces *A maculipennis* in certain places to bite domestic animals to the practical exclusion of man or just what measure of contact between a given species of anopheles and man is necessary to maintain endemic malaria, cannot now be answered But if in spite of what I said about generalizations I may be allowed to hazard a very conservative and obvious one I would say that the fundamental similarity between all and diverse kinds of anophelines which transmit malaria in the world is that they all readily bite man and bite him repeatedly however widely they may differ in other bionomic characters

This is so axiomatic that the field of inquiry to which it points would seem to have been insufficiently explored No doubt it could help us to determine in the presence of a multiplicity of anopheline species the few which are dangerous to our health and to explain why the same anopheline may be a malaria vector in one region and quite harmless in another But I have been interested here not so much *in out*lining specific problems as in trying to show

that entomology in the service of epidemiology is a fundamental necessity in the study and control of malaria

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By FREDERICK L HOFFMAN LL D †
Wellesley Hills Mass

My remarks on the present occasion cover a wide range of international efforts to reduce the incidence of malaria in some parts of the world to the vanishing point But the problem still remains an enormous difficulty demanding a concentration of qualified attention on the part of engineers entomologists physicians research workers and scientists generally Malaria is now however infinitely less a mortality problem than a disease problem particularly in this Country during recent years Malaria as a disease also seriously affects many other and more important diseases hastening death in countless cases in which the organism has been weakened by continued attacks of malaria in fection

My review covers some thirty different countries which it would be impossible to deal with even in the form of a very brief summary The address will therefore be printed together with the reprints of all my previous papers on malaria and made available to those who wish to pursue the subject further particularly from a statistical point of view

In the United States Registration Area the mortality from malaria has gone down from 3 8 per 100 000 in 1919 to 2 7 in 1927 but for the previous year the rate was only 1 9 so that the increase during the year is suggestive of the urgency of renewed efforts on the part of all concerned The most conclusive evidence of malaria reduction in this Country under adequate conditions of control is furnished by the United States Army The disease incidence has been reduced since 1902 from a rate of 201 2 per 1 000 military personnel to 6 7 in 1927 For white enlisted men the rate at Panama which

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*Read b f r Nati al Malaria Committ e (C nfer nce n Mal i) m ti g conjointly with S uth rn M di l A iati n Tw nty S c d A al Me ti g A h ille N th C r li a Nov mb 1 15 19 8

†Co s lti g Statisti ia Prudenti l I rance C mpany

as late as 1921 had been as high as 1[illegible] per 100,000, had been reduced to 499 during 1927. There had been no deaths from malaria in the Panama Canal Zone among Panama Canal employees since 1924.

Another outstanding experience of malaria control is represented by the admirable efforts of the United Fruit Company in its tropical possessions in the West Indies and Central America. The Company in recent years has been experimenting with treatment by plasmochin with excellent results. Attention in the paper is directed to outbreaks of malaria in sections heretofore considered immune. A most interesting occurrence of this kind is the recent outbreak of malaria in [illegible] which was considered entirely free from the disease and not liable thereto. On the other hand, attention is directed to the extraordinary frequency of malaria in Southern Russia. [illegible] Incidentally, [illegible] also regarded to have been [illegible], was unfortunately [illegible] from [illegible]. In 1923 the number of reported cases in the Union of Soviet Republics was [illegible] 2,3[illegible], but this by 192[illegible] had been reduced to [illegible],141,[illegible].

[illegible] malaria survey can ignore the great work made in Italy. The death rate from malaria in Italy, which had been [illegible] per 100,000 in 1914, had by 1918 increased to [illegible], but the rate was reduced to [illegible] during 192[illegible], which was the lowest figure of recent years and which contrasts with a figure of [illegible] during 1[illegible].

In Ceylon, for example, the problem is a yet far from being under perfect control. The number of cases of malaria treated in dispensaries in 1926 was as high as [illegible], aside from about 49,000 more serious cases treated in hospitals.

For all India, the figures are still more startling. The number of outdoor malaria patients treated at dispensaries increased from [illegible],19[illegible] cases in 1916 to 7,[illegible] cases in 1925, aside from 1,[illegible] more serious cases treated in hospitals.

The foregoing random observations merely emphasize the plea frequently made in the last fifteen years that there is the utmost urgency for a more concentrated effort, but most of all for continuity of effort, supplied by a considerable amount of skill and money if reductions are to be of genuine and lasting value. The problem will solve itself, but it is in need of a vast amount of cooperation for the collection of adequate and trustworthy statistics.

[illegible] agency in this country in this connection can serve a better purpose than the National Malaria Committee in cooperation with the United States Public Health Service, which is [illegible] and has aimed at the gradual eradication of malaria throughout the southern states. But these two agencies, together with the health agencies of the different states, require much more assistance than has thus far been forthcoming. The road to success will be through continuous efforts, which should not be relaxed when temporary results of value have been attained. At present, there is too much sporadic outbreak [illegible] which hinders rather than helps the real cause of success.

DISCUSSION (Abstract)

Dr. L. L. Williams, Jr., Richmond, Va. [illegible]

[illegible]

A NEW METHOD FOR MALARIA CONTROL [illegible] PARIS GREEN AS [illegible] PRELIMINARY REPORT*

By J. A. [illegible]

and

H. A. [illegible]

Memphis, Tenn.

Since 1921, when Doctor Barber, of the United States Public Health Service, discovered the high toxicity of paris green against Anopheles larvae, the use of this material has steadily increased, and today it is well known in practically all of the malarious parts of the globe.

For a long time paris green in the ratio of one part paris green to one hundred parts fine dust was restricted to hand distribution. Although it is still remains a standard method, the

[illegible]

[illegible]

[illegible] United States Public Health [illegible]

distribution by mechanical means is of necessity gaining attention. Knapsack dusters have been used successfully, while Williams and Cook have developed a very effective method of distribution from airplanes using as high as 33 per cent paris green diluted with soapstone.*

Between the hand method for small areas and the airplane method for large tracts there has arisen a demand for a dusting device that would be mobile economical easily operated and effective over areas not covered by the other methods. With an idea that such a device could be most advantageously operated from a light boat the authors proceeded during the season of 1928 to develop a power duster and method of operation that would ultimately prove satisfactory.

A boat of the skiff type 14 feet by 50 inches was procured propelled by a small outboard motor. The blowing equipment consisted of a 600 watt gasoline engine generator unit and a 100 watt electric driven hand blower. A hopper was installed with an agitator similar to that of the well known flour sifter. This sifted the dust by hand power into the intake pipe of the blower. The dusting outfit proper weighed less than an average sized man and could be carried on the running board of a car. It sits in the boat on spring legs and does not have to be bolted to the boat. Thus it can be easily moved from pond to pond.

In operation 5 to 15 per cent paris green mixed with ordinary hydrated lime was blown diagonally into the air as the boat moved along. Six to ten feet after leaving the nozzle it was picked up by air currents and floated across the area. The distribution was excellent and no heavy, dense coverage of dust occurred near the boat. It is believed that the lightness of hydrated lime was partly responsible for the effective distances covered. The passage of the dust through the fan of the blower materially aids in the diffusion.

In a series of tests of this device at Reelfoot Lake Tennessee in areas of dense lily water star grass moss and algal mats we were consistently able to kill all Anopheles larvae up to 450 feet from the boat. The time of application was less than five minutes per acre. One half pound paris green per acre was found sufficient at this place. The cost of materials (with paris green 20 cents a pound) was therefore approximately 14 cents per acre. The whole outfit can be operated by one man.

Although the device has not been perfected to the point desired it has already shown itself to be efficient simple and economical to operate and well adapted for work in areas where no other method of control is feasible. Other blowers can be added without necessitating extra help and the entire device is extremely flexible for almost any imaginable situation. The complete outfit including boat and outboard motor can be set up for a sum not exceeding $500.

While this is a preliminary report only and a complete report of the performance of the device will be published later something should be said in regard to commercial paris green available for anti anopheles work.

Numerous instances are on record where paris green has utterly failed to accomplish its purpose and reliable workers have reported poor results with its use. During the past season's work we had occasion to observe the effectiveness and non effectiveness of two different brands of paris green. With one we got almost no destruction of Anopheles larvae while with the other we got practically 100 per cent killing. No attempt will be made here to explain the variance of these two samples.

Paris green is stated to be a by product. It varies in color density fineness dryness specific gravity and probably in chemical composition. Its varying toxicity is said to be the chief reason why it has been replaced in agriculture by other poisons. The paris green which proved very effective in our experimental work was of a dense vivid uniform color and very dry. The manufacturer stated that in tests 95 per cent would pass a 350 mesh bolting cloth such as is used for paint pigments.

It is quite evident that a detailed investigation is necessary in relation to the suitability of paris green for Anopheles control. The time is not far distant when for this work paris green will be purchased according to specifications. What these necessary specifications are we do not yet know but the United States Public Health Service is at present undertaking an exhaustive study of paris green and it is believed

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*Reprint No 1140 from the Public Health Reports

that in a short time much valuable additional information on the suitability of paris green for anti anopheline work will be available

DISCUSSION (*Abstract*)

Dr Felix J Underwood Jackson Miss—I should like to ask if you worked on a calm or windy day?

Mr H A Johnson Memphis Tenn—We operated on Reelfoot Lake under many conditions of wind velocity We found no days upon which the dust would not travel The most satisfactory wind velocity for dust carriage was found by a small pocket anemometer to be from two to five miles per hour Above five miles per hour considerable vertical motion of the dust cloud was noted and there was a corresponding tendency for the dust to skip certain small areas of vegetation

THE MISSISSIPPI LAW AND PROGRAM FOR SALT MARSH MOSQUITO CONTROL*

By T H D Griffitts M D †
Biloxi Miss

So far as the writer knows the first effort that was made in the United States toward the investigation of state wide mosquito problems was that by the late Dr John B Smith State Entomologist of New Jersey in 1900 In that year according to published records Dr Smith who in addition to filling the position of State Entomologist was Entomologist to the New Jersey Agricultural Experiment Station secured a small amount of money from the director of the station for a preliminary investigation of the mosquito problem One of the results of this preliminary investigation was the introduction of a bill in the State Legislature in 1902 which provided for an appropriation of $10 000 00 for the study of the mosquito problem This measure failed of passage that year but the Governor of the State set aside from his emergency fund the sum of $1 000 00 with which Doctor Smith carried on the work in 1902 In 1903 the Legislature made an appropriation of $10 000 00 by the passage of a bill similar to the one introduced in 1902 Doctor Smith submitted a report published in 1904 showing among other facts that 'salt marsh mosquitoes migrated as far as 30 miles inland infesting seriously more than one half of the State and annoying very seriously nearly three fourths of the State s population "

Impressed by the facts presented by Doctor Smith, the Legislature of New Jersey in 1905, passed a bill one of the provisions of which offered state aid to communities 'that cared to spend their own funds in salt marsh drainage for mosquito control ' For the fiscal years 1905 6 the sum of $10,000 00 was appropriated for state aid to communities and an additional sum of $6 000 00 for the use of the Agricultural Experiment Station for the execution of the law and for investigations and experiments Only one community (the City of Elizabeth) took advantage of the law so all but $1 000 00 reverted to the State Treasury The Legislature in 1906 passed an act providing for a survey of all the salt marsh areas within the State and for the abolition of breeding areas the State to cooperate financially and otherwise with communities or political units, the State not to contribute more than $500 00 in any single municipality The Director of the State Agricultural Experiment Station was authorized to expend annually such an amount as was appropriated by the Legislature The aggregate sum which could be appropriated was limited to $350 000 00 this having been the amount estimated by the State Entomologist as necessary for the completion of the initial drainage of the marshes in the State

Actual work on the drainage of the salt marsh areas of New Jersey for the elimination of mosquitoes began in 1906 under the provisions of the foregoing law In 1912 this law was supplemented by one providing for 'the establishment of county mosquito extermination commissions and to define their powers and duties A law of 1915 made the Director of Health of the State of New Jersey ex officio member of each county mosquito commission Under the acts of 1906 and 1912 (with amendments in 1915 and 1919) the State of New Jersey has been successfully carrying on her fight against salt marsh mosquitoes largely by drainage

Owing to repeated serious invasions by salt marsh mosquitoes in vast areas along the South Atlantic and Gulf Coasts the Congress, in June 1926 appropriated for the use of the United States Public Health Service in cooperation with the Bureau of Entomology of the United States Department of Agriculture the sum of $25 000 00 for a preliminary survey of the salt marsh areas of the South Atlantic and Gulf States to determine the exact character of the

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Second Annual Meeting Asheville North Carolina November 1 15 19 8

†Epidemiologist United States Public Health Service

breeding places of the salt marsh mosquitoes in order that a definite idea may be formed as to the best methods of controlling the breeding of such mosquitoes

By this Act and subsequent appropriations (aggregating $50,000 00) the Federal Government has for the first time officially recognized the importance of the salt marsh migrating mosquitoes in their effect on the general welfare of the Atlantic and Gulf Coast sections

Headquarters for the survey were established at Biloxi on the Mississippi Gulf Coast Based on determinations made in the first two years of the survey, and the desire to inaugurate much needed control measures the Mississippi Legislature passed an act which became a law in April, 1928 providing for the appointment and functioning of County Mosquito Control Commissions and for special taxation by counties to secure funds for carrying on the work

The Mississippi mosquito control law is as follows

An Act enabling the establishment of County Mosquito Control Commissions and to define their powers and duties and for other purposes

Section 1 Be it enacted by the Legislature of the State of *Mississippi* That the *county board of supervisors* in any county of this State may with the approval of the State Health Officer appoint *three* persons who will constitute a board of commissioners of said *county to be known as "The County Mosquito Control* Commission (inserting the name of the county) and for which the commissioners are appointed) The Commissioners first appointed under the provisions of this Act in any county shall hold office respectively for the term of one two and three years as indicated and fixed in the order of appointment and all such commissioners after the first appointment shall be so appointed for the full term of three years vacancies in the said commission occurring by resignation or otherwise shall be filled by *the County Board of Supervisors with the approval of the State Health Officer* and the persons appointed to fill such vacancies shall be appointed for the unexpired term only such persons so appointed when duly qualified constituting such commission and their successors are hereby created a body politic with power to sue and be sued to use a common seal and make by law the member of any such *commission shall serve without compensation* except that the necessary expenses of each commissioner for actual attendance of meetings *and per diem of $[illegible] 00 the total per diem not to exceed $25 00 for any one commissioner per month* of said commission shall be allowed and paid *The president and secretary shall furnish bond in the amount of $5,000 00 each the fee for same to be charged to available funds obtained for the work herein mentioned* No persons employed by the said commission shall be a member thereof before entering upon the duties of his office each commissioner shall take and subscribe an oath or affirmation before the clerk of the county in and for which he is appointed to faithfully and impartially perform the duties of his office which oath or affirmation shall be filed with the clerk of the county wherein the commission of which he is a member is appointed every such commission shall annually choose from among its members a president and treasurer and *employ a director who is trained in mosquito control operations and whose duty it shall be to direct the work of the commission as its executive* a clerk or secretary and such other help as it may deem necessary to carry out the purposes of this Act it may also determine the duties and compensation of such employees, and make all rules and regulations respecting the same It shall be the duty of the *county board of supervisors* in each county to provide such commission with a suitable office where its *meetings may be held* its maps plans, documents records and accounts shall be kept *and office work carried on The commission shall hold monthly meetings and not less than two members shall constitute a quorum*

Section 2 The *State Health Officer* shall be a member ex officio of each commission and shall cooperate *with them for the effective carrying out of their plans* and work The said *State Health Officer shall serve* without compensation except that the necessary expenses actually incurred by him in the attendance of meetings of said commissions shall be allowed and paid The *State Board of Health or its representative* shall *upon request of the commission* furnish *the said commissions with such surveys maps* information and advice as *may be available* for the prosecution of the work or as in their opinion will be advantage in connection therewith *the expense of surveys being paid in whole or in part by said commission*

Section 3 *Two or more counties may combine for the purpose of carrying out the provisions of this Act in the respective counties each county retaining all rights set forth in this Act but the commissioners in the counties combined may enter into agreement to employ for purposes of economy the same director and other personnel for the work of the commissions in the counties so combined all expenses including salaries labor material and the like being paid by the county in which the work is performed*

Section 4 *The county board of supervisors and board of commissioners so appointed may with the approval of the State Health Officer receive and accept any aid whatsoever from any source calculated to further the success of a plan or plans based on the provisions of this Act*

Section 5 Every such commission shall have the power to eliminate all breeding and *producing* places of mosquitoes within the county wherein it is appointed and to do and perform all acts and to carry out all plans which in their opinion and judgment may be necessary or proper for the *survey and* elimination of *breeding and producing* places of mosquitoes or which will tend to exterminate mosquitoes within said county

Section 6 Said commission shall on or before the first day of November each and every year file with the *State Health Officer* a detailed estimate of the moneys required for the ensuing year and a plan *of the work to be done and the method to be employed* The said *State Health Officer* shall have the power to approve modify or alter the said estimates, plans and methods and the estimate plan and method finally approved by him shall be forwarded to the *county board of supervisors* in each county on or before the [illegible] st day of December following its receipt

Section 7 The *county board of supervisors* of each county or other body having control of the finances

thereof *may* include the amount of money approved by the *commission and the State Health Officer* annually in the tax levy provided however that in no year shall the amount so raised exceed the amount hereinafter specified to wit in counties where the assessed valuations are *less than* \$20 000 000 00 a sum not greater than *one* and *one half mills* on every dollar of assessed valuations *in counties where the assessed* valuations are \$20 000 000 00 *or over* a sum not more than *one mill* on every dollar of assessed valuations

Section 8 The moneys so raised or so much thereof as *may* be required may be paid from time to time for the *operations work materials and labor of said* commission duly signed and approved by the president and secretary thereof *by order of the board of supervisors*

Section 9 It shall be the duty of each commission annually on or before the *20th day of January* in each year to submit to the *State Health Officer and to the county board of supervisors* in their respective counties a report setting forth the amount of moneys expended during the previous year the methods employed the work accomplished and any other information which in the judgment of the *board of supervisors* may seem pertinent

Section 10 Nothing in this Act shall be construed to alter amend modify or repeal any act now existing conferring upon State or local boards of health any powers or duties in connection with the extermination of mosquitoes in said State but shall be construed to be supplementary thereto

Section 11 *Provided that this Act shall only apply to counties bordering on tide water and on the Mississippi River*

Section 12 This Act shall take effect immediately *upon its passage and approval*

Approved April 23 1928

This law, in its main features, is quite similar to the law under which the State of New Jersey is ridding itself of the great salt marsh pests The parts of the Mississippi Act appearing in *italics* are those differing from the New Jersey act . Sections 3 and 4 are new and provide for the combining of two or more counties for purposes of economy, efficiency and coordination of efforts and for the acceptance of aid from any source calculated to promote the success of the plan or plans adopted

To summarize the Mississippi salt marsh mosquito control law provides for

(1) The appointment by the county board of supervisors with the approval of the State Health Officer of a mosquito control commission to be composed of three members each serving for a term of three years each member to receive actual expenses and a per diem of \$5 00 which per diem shall not aggregate more than \$25 00 per month The commission is to employ a trained director other personnel and labor and provide an office

(2) The State Health Officer is a member ex officio of *each county* commission receives actual expenses and provides for surveys, maps information and advice

(3) Two or more counties may combine for purposes of economy efficiency and coordination of the work

(4) The counties may with the approval of the State Health Officer receive aid from other sources

(5) The commission has power to survey and to eliminate all breeding and producing places of mosquitoes in the county

(6) The commission on or before the first day of November of each year shall file with the State Health Officer an estimate of moneys needed and plans for work for the ensuing year and he has authority for *final approval*

(7) The county board of supervisors may include the amount of money approved by the commission and State Health Officer in each annual tax levy In counties where the assessed valuations are less than \$20 000 000 00 the rate shall not be greater than *one and one half mills* in counties of \$20 000 000 00 or over the rate is not greater than *one mill* on every dollar of assessed valuations

(8) Expenditures are to be made upon the written approval of the commission and by order of the board of supervisors

(9) An annual report to the State Health Officer and the county board of supervisors is required of the commission

(10) The Act affects no existing Act except that it supplements existing laws

(11) The law while primarily aimed at salt marsh mosquito control in the three coastal counties also applies to those counties bordering on the Mississippi River

The survey made by the United States Public Health Service has shown the economic feasibility of the control of salt marsh mosquito breeding in Mississippi, largely by drainage This State is fortunate in having the least marsh acreage of all the Southern states, having approximately *26 500 acres of salt marsh (Harrison County* 2 300, Hancock County, 5 200 and Jackson County 19 000 acres) This amount includes the mainland marshes and the marsh areas on the off shore islands (Petit Bois Island Horn Island Ship Island, Deer Island and Cat Island) According to the soil conditions these marsh areas are divided into two classes muck marshes occurring generally at the mouths of rivers from silt brought down stream, and sand or sandy loam along main shores or on the islands Drainage in the muck marshes is the more satisfactory method of control as to cost and permanency but drainage (necessary for mosquito control) is feasible in either class Much of the marsh areas particularly the muck islands, are so covered by daily tides as not to be producers of mosquitoes This reduces the areas actually demanding control work to approximately 6 000 acres Based on costs of similar work and added expense on account of transportation to islands etc it is estimated that the initial cost of mosquito drainage for Mississippi will be approximately \$60 000 00 or \$10 00 per acre

One county (Harrison) has already appropriated \$20 000 00 and will start drainage by February of next year it is stated It was hoped

that the other two coastal counties would make appropriations for the ensuing year but they have failed to do so. It is believed that based on the survey made by the Public Health Service, Mississippi through local appropriations for the work and detailed surveys will eliminate the salt marsh mosquito pests as well as the two salt water Anopheles (*crucians* and *atropos*).

Contributing to the general movement to control salt marsh mosquitoes, the States of Virginia and Florida have already passed laws similarly dealing with the problem while other states, recognizing the feasibility of control its economic and public welfare aspects are becoming interested in plans. It is not too much to expect that within a few years the populated coastal sections will have taken steps to control this great enemy of man and beast.

DISCUSSION (*Abstract*)

Dr John H Hamilton, Wilmington, N C—Being from the eastern part of North Carolina I am cognizant of the handicap to which we are subjected by the salt marsh mosquito. I believe Doctor Griffitts has devised a plan which will enable us to do something about this matter.

Our people are not content to be rid of Anopheles mosquitoes only. They demand freedom from all mosquitoes.

Whenever we start a malaria program which affects Anopheles we must plan to control all mosquitoes that are capable of biting.

Dr L L Williams Jr, Richmond, Va—It should be noted that the Mississippi law covers mosquito control other than that of the salt marsh mosquito.

In the malaria sections of the State of Mississippi Anopheles control on a county wide basis can be attempted. The county health department is the essential nucleus for Anopheles control.

I believe we can create a demand for malaria control through mosquito control rather than just pest control. Heretofore we have been very much handicapped: we started out with expensive drainage and oiling which did not apply to rural districts; then we restricted the area of control and the type of control to *quadrimaculatus* only; then we had paris green and now the screening program. I am inclined to believe that with all these plans combined *Anopheles* control on a county wide basis has at last come within the scope of the people; the time has come for us to push that plan. If we can get a county health department to undertake mosquito control then that is all right; if not we must organize some commission for county wide mosquito control.

Dr C W Garrison, Little Rock, Ark—Has the State of Mississippi made an appropriation for State aid of counties effecting malaria control under this Act?

Dr Felix J Underwood, Jackson, Miss—No. This Act of the Legislature does not carry an appropriation and has nothing to do with the appropriation for the State Board of Health.

Dr G Griffitts (closing)—I mentioned that Virginia and Florida had passed laws providing for salt marsh mosquito control.

The Virginia law I understand provides for state aid to local work and applies only to the tide water section; consequently has to do with salt marsh mosquitoes only. The Mississippi law like most other laws is not offered at first as a finished product. It very probably will need amendments from time to time after control work is well under way. There may be objections in some states to the creation of an additional commission as provided for in the Mississippi Act. For instance in Florida it is generally felt that the county boards of supervisors should constitute the mosquito control commission and handle the control work directly. Generally speaking there is a prejudice against a multiplicity of boards or commissions, and I know of no reason why under such circumstance the county board of supervisors should not take on this added function.

It is a source of gratification that the first county in the South Atlantic and Gulf States to make an appropriation for salt marsh mosquito control as a direct result of the preliminary survey which is being conducted by the Public Health Service was Harrison County, Mississippi, in which the headquarters for the survey are located. It is expected that the other two Mississippi coastal counties will make proper appropriations very soon and that general public sentiment will create a demand for concerted action in all of the Atlantic and Gulf states included in the survey. The damage done by the salt marsh mosquito has already been recognized as one of interstate importance and I feel sure now that the ultimate result of the survey undertaken by the Federal Government will be the reduction of salt marsh mosquitoes to the point where they will not be a ruling influence in the coastal section.

PREVALENCE OF MALARIA IN HUMPHREYS AND SUNFLOWER COUNTIES MISSISSIPPI IN 1927-1928*†

By Paul S Carley, M D ‡
Belzoni, Miss

and

Marshall C Balfour, M D ‡
New York, N Y

The State of Mississippi has had the reputation of being one of the most heavily infected malaria sections in the United States. While there are parts of the State from which malaria is seldom reported the area known as the Mississippi Delta is the one in which the greatest prevalence of the disease is generally conceded. About 25 per cent of the population of the State resides in the Delta and more than 50 per cent of all the malaria reported to the State Board of Health is reported from that section. Hum-

*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Second Annual Meeting, Asheville, North Carolina, November 12-15, 1928.

†The studies were carried out under the auspices and with the support of the Mississippi State Department of Health and of the International Health Division of the Rockefeller Foundation.

‡Field Staff, International Health Division, Rockefeller Foundation.

phreys and Sunflower Counties lie in west central Mississippi in the Delta The topography of both counties is flat and the soil is a rich alluvial deposit Each county is transversed by numerous small water courses lakes and swamps are numerous Humphreys County lies directly south of Sunflower County and was completely inundated by the floods of the spring of 1927 while Sunflower County was flooded on its lower third

In 1920 Sunflower County had a population of 46 374 Humphreys in that year had a population of 19 192 In both counties the racial ratio is about one white to three negroes The estimated population computed for 1927 gives *Sunflower County 58 920* and Humphreys County 20 683 inhabitants In both counties the major industry is the raising of long staple cotton The general economic condition of the inhabitants may be rated as fair More specifically the economic condition of the counties reflects, from year to year the market price of cotton

Some of the first work done in malaria observation and control in the United States was carried out in Sunflower County and the adjoining (Bolivar) County by [illegible] and his associates in 1916 1918 Their data on [illegible]dence of malaria included histories and the results of thick blood film examinations In 1918 an area of 100 square miles in Sunflower County was surveyed, which included 8 053 persons of all ages A positive history of malaria signified one or more attacks of malaria in the previous twelve months Among this group 36 3 per cent gave positive histories while in a group of 7 639 persons *22 2* per cent showed positive bloods In Bolivar, the adjoining Delta County during 1916 1917, 31 459 persons living in an area of 328 square miles were interviewed and examined The positive history index was 40 per cent and the blood index was 21 2 per cent Bass added the number of positive histories and the number of positive blood examinations occurring among the persons who gave negative histories and arrived at an index of about 50 per cent as representing the prevalence of malaria in those areas of Sunflower and Bolivar Counties at that time Whether or not we accept a positive history as a criterion of malaria infection it must be admitted that the blood indices of 21 and 22 per cent obtained by only one examination represent for those two counties in 1916 1918 less than the actual amount of acute and chronic malaria which was indeed a high incidence of the disease

After an interval of ten years the State of Mississippi, and the Delta in particular still have the reputation both among physicians and the laymen of having a high incidence of malaria Most of the evidence in support of this opinion comes from the number of cases of malaria reported monthly to the State Bureau of Vital Statistics Relatively few of these reported cases are supported by blood examination In 1927, 88 302 cases of malaria were reported from the whole State giving a case rate of approximately 49 per 1,000 A summary of the blood examinations made for the diagnosis of the disease in the state county and city laboratories reporting to the *Division of* Malaria Control of the State Board of Health is given below

Year	Total Exam	Positive Exam.	Per Cent Positive
19[illegible]4	10 331	1 98	19 %
19	11 630	1 699	14 6%
19[illegible]6	10 491	1 493	14 %

It may be observed that for the three years from 1924 1926 about 10 000 blood smears have been examined annually in the public laboratories Of these suspected cases *15 to 20* per cent have been found positive On the other hand the positive blood examinations represent only [illegible] 2 per cent of the total number of cases of malaria reported The majority of these reports, therefore, are clinical diagnoses

Chart I shows the malaria case rate per 1 000 population in the two Delta counties considered in this report and in the six surrounding counties from 1919 1927 According to these data, 7 5 per cent of the population of Humphreys County and 10 per cent of the Sunflower County population came under the observation of the county physicians in 1927 because of malaria. It has been stated that only one of three or one of five cases of malaria is seen or treated by a physician If so a rather *formidable sickness* rate due to malaria must occur in these counties Whatever may be the accuracy of the morbidity data it is reasonable to note since 1919 there has been a distinctly do[illegible] trend in the malaria morbidity rate in [illegible] ties included in the graph

Since very little data are available [illegible] the present status of malaria by surveys [illegible] population at large it may be of [illegible] present the results of spleen and blood [illegible]tions in Humphreys and Sunflower Co[illegible] in 1927 1928

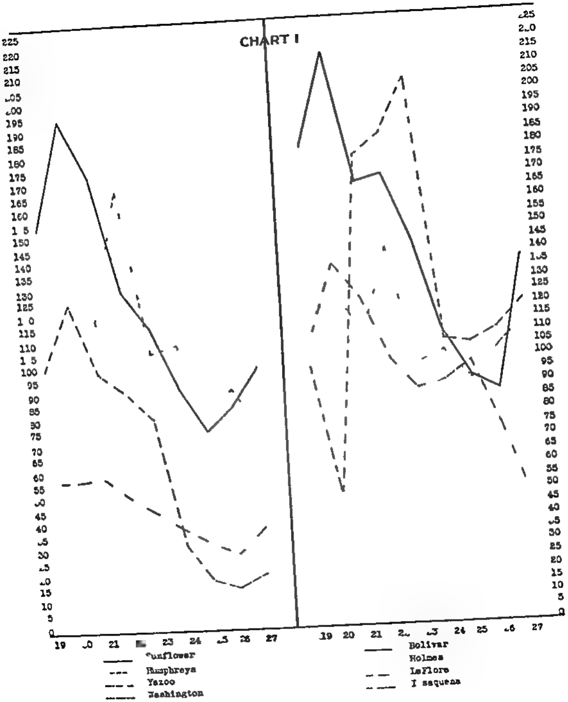
CHART I
Sunflower
Humphreys
Yazoo
Washington
Bolivar
Holmes
LeFlore
I saquena

In *Table 1* the results of spleen examinations carried out in the counties are summarized by age groups

TABLE 1

Spleen Examinations

County	No [illegible]xam	Age Groups 5	5 9	10 14	15 up	No Pos	Spleen Rat
Wh te—							
Humph eys	427	0	217	1 9	31	15	
Sunflower	401	3	169	1 5	104	18	
Total	828	3	386	304	135	33	4 0%
Colored—							
Humphreys	980	94	414	436	[illegible]	[illegible]	
Sunflower	188	45	67	[illegible]	47	3	
Total	1168	139	4 5	475	83	13	1 1%

Age Distribution Palpable Spleens Both Counties

	5	5 9	10 14	15 up
White	0	17	13	3
Colored	0	7	4	

All spleen examinations were made on school boys The boy being examined was placed in the dorsal decubitus position and the legs flexed The examination was carried out on the bare abdomen Only those spleens which could be felt on normal respiratory effort or which ex tended below the costal margin were noted as positive We agree with Maxcy Barber and Komp[2] that the inclusion of spleens palpable on forced respiration or by very delicate ex aminations tends to include too large a group of normal spleens in the positive group The [illegible] sults of these examinations give a spleen rate among a group of 828 white school boys of 4 per cent The variation in the spleen rate in the two groups is attributed to racial differences rather than any difference in opportunity of becoming infected with malaria for as Clark[3] and others have pointed out, it seems that the negro is less liable to show splenic enlargement than the white

TABLE

Bl od Examinations

Co nty	Number Exam	Age Groups [illegible]	5 9	10 14	15 up	Number Po ti e	Blo d Rate
White—							
Humph ys	4 7	0	217	179	31	7	
Sunfl wer	57	3	219	149	06	3	
Total	1004	3	436	328	37	10	1 0%
Col red—							
Humphreys	37 3	48	841	931	1703	5	
Sunflowe	64	1 1	127	9	437	3	
Total	4487	369	968	1010	140	8	1 7%

Age Distribution Positive Case Both Counties

	No Exam	5	Ag G oup 5 9	10 14	15 up
White	10	1	5	4	0
Colored	8	1	28	31	18

Table 2 shows the results of blood examina tions in both counties, summarized by age groups

All blood examinations reported were done on thick films dehemoglobinized with distilled wa ter and stained with Giemsa s stain At the time the thick film was obtained in the field a thin smear was made on the opposite half of the slide In all cases reported as positive the film was examined after the diagnosis had been made from the thick smear for confirmation *

Table 3 shows the number of blood examina tions by months and is further divided to show the type of parasites found in the positive smears

TABLE 3

	Number Exam	Positive all Types	Per Cent Positive	Po itive P Vivax	Positive P Falcip	Positive P [illegible]ala iae	P itive Typ Und t rmin d
19 7							
Aug	187	9	5	0	3	0	6
Sept.	866	[illegible]	1 5	11	2	0	0
Oct	71	13	1	6	3	2	0
Nov	1 9	6	5	5	0	0	0
Dec	104	2		0	1	0	1
19 8							
Jan	04	14	2 8	13	1	0	0
Feb	146	3	2	3	0	0	0
Mar	351	2	0 9	2	0	0	0
April							
May	1 3	0	[illegible]	0	0	0	0
June	1317	16	1 2	8	3	0	5
July	505	5	1	1	3	0	1
Aug	488	4	8	1		0	1
Total	5491	88	1 6%	9 %	20 %	%	19%

The blood index for a total of 5 491 examina tions is 1 6 per cent The highest monthly rates were found in August and November, 1927, but this monthly variation is not particularly sig nificant owing to the rather limited number of examinations during these months The divi sion of the 88 positive examinations shows 59 20 2 and 19 per cent for vivax falciparum, ma lariae and undiagnosed types respectively

In Humphreys County selected houses were visited at least once a fortnight during the pe riod reported and Anopheles were caught in side and under the houses No specimens of any Anopheles except *A quadrimaculatus* were

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Th authors are very g at ful to Dr T W Kem merer Di ector of the State Hygienic Lab ratory of Mi issippi and to Dr Ma [illegible] F Boyd Di ector of the Station f Fi ld Studi in Malaria at Edenton N C f r their assista c in interpr tation f many of the blo d pecimens collect d in thi survey

found inside the houses During all collections in barns and under houses in the period under consideration only twenty four specimens of *A punctipennis* three specimens of *A pseudo punctipennis* and one specimen of *A crucians* were taken The following table shows the total number of *A quadrimaculatus* caught monthly the number of inspections made and the average number of *A quadrimaculatus* caught per house (*ten minutes search per house*)

TABLE 4

	Month	Total No A Qu Caught	Number of Houses Exam	Av No A Q per House
19 7	August	316	0	15 6
	[illegible] pt mber	1 48	[illegible]	14 1
	Oct b	51	42	6
	No emb r	109	39	5
	D cember	1	0	17
1928	January	33	5	9
	Februa y	21	41	5
	Ma h	40	37	1 0
	April	110	2	5
	May	14 7	72	19 7
	Ju e	013	130	15 4
	July	865	45	19
	Augu t	80	48	16 6
	Septemb	785	39	15
	O t b	[illegible]	21	3 3

The results serve to emphasize the already known fact that *A quadrimaculatus* greatly predominates over all other species of anophelines in the Delta of Mississippi

SUMMARY

There are presented the results of 1 996 examinations for splenic enlargements on colored and white school boys together with the results of 5 491 thick blood film examinations on blood specimens obtained from colored and white residents in two Mississippi Delta counties The malaria morbidity rate based on physicians reports for these counties and six surrounding counties during the period 1919 1927 is given The results of routine search for anopheline mosquitoes at selected stations in Humphreys County during the period *August 1927 to October* 1928 is added

Judging from the number of cases reported to the State Board of Health by practising physicians in the area studied there has been a definite downward trend in malaria morbidity

The results of spleen examinations indicate that 4 0 per cent of white school boys and 1 1 per cent of colored boys in the area under observation showed palpable splenic enlargement on one examination

The single examination of 5 491 blood specimens gave a blood index of parasite rate of 1 6 per cent This shows an enormous decrease in the ten years since the observations made by Bass in one of these two counties

The anopheline density is high in Humphreys County and *A quadrimaculatus* is the overwhelmingly predominant anopheline

From the results of spleen and blood examinations it may be stated that there [illegible] wide discrepancy between the malaria rate as reported by practising physicians and the amount of malaria demonstrable by physical or laboratory methods

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M x y K F B b M A a d T omp W H W On th S gnifi nce of Spl Palpati o De [illegible] Inspi t on in th M m nt f Mala i R p t [illegible] 1194 f m the Publ H alth R p t pr 010 0 1 De 9 19 7

3 Cl rk H S Spl e s a d Pa it Rat a Measu of Mala ia in the C ibbe A a Ame J T op Med 8 4 3 442 Sept 19 8

DISCUSSION (*Abstract*)

Dr M A Barber Greenwood Miss—In Leflore County Mississippi we obtained somewhat higher blood parasitic indices than those obtained in Humphreys and Sunflower Counties by Dr Carley In the April and May 1928 examinations 240 white school children gave 6 3 per cent positive These children lived in the country only rural pupils were examined among the children of the schools of larger town In the autumn of 1928 the same schools ga e 5 2 per cent p siti e Negro rural schools [illegible] e a somewhat higher rate of 365 child en examined i the pring of 1928 21 6 per cent were positive The autumn examination of these negro schools has not yet been finished but it p omises to give a lower rate than that of the pring Of negro children in larger towns 198 ga e 5 1 per cent positive in the pring examination of 1928 Of a total of 862 school children of both races exam ed durin the sprin of [illegible] 8 12 9 per cent were positi [illegible]

Probably we i cluded in ou examinations a larger percentage of small rural chools than Dr Carley did in his *er es and uch selection may partl account for* our hi her rates

Apparently the rates obtained [illegible] th County during the fall of 19 7 and p n of 1928 are [illegible] her than those we are gettin dur the autumn of 1928

I have been obtain n some interest ng results from the monthly re e amination of a group of negro children found blood *positive in the pr n of 1928 The* work has not been completed but t would appear that in a group of th s kind a gle examination may reveal less than half of the para itic carriers At all events so many of the negatives btained at a gi en examina t on subsequently become po t e that it is hard to attribute the result to re infections

I believe that the examinat on of blood for malaria

parasites gives more satisfactory results in the determination of endemic malaria as it occurs in this Country than does any other single test The difficulties of the blood examination are commonly exaggerated The main thing is to use thick smears and have them properly collected and stained In working with poor preparations one suffers much eye strain and loss of time in trying to distinguish parasites from finger dirt. With good preparations an examination of two minutes per thick specimen may be as good as five minutes or more on a poor one

Dr M C Balfour New York N Y—The paper presented by Doctor Carley had several objects (1) to call your attention to the remarkable drop in the blood index of a large group of people living in the Mississippi Delta as compared with the blood indices found ten years ago when Dr C C Bass made observations in the same area (2) to present evidence regarding the relatively low incidence of malaria as measured by the blood and spleen indices at the present time and (3) to point out the wide discrepancy between malaria morbidity based on physicians clinical reports and the measurement of malaria incidence obtained by spleen and blood examinations

To supplement Doctor Carley's paper it may be observed that the blood index reported by him as 2 per cent or less represents the average for the year The blood indices by months varied of course However the month in which the highest rate existed was not more than 5 or 6 per cent

The persons examined represent fair samples of the two counties In Humphreys and Sunflower Counties there are no towns or cities which have a population of over 2 200 therefore the area is essentially rural Some of those examinations were made on town children but the majority of them were of children living on plantations

Dr L W Hackett New York N Y—I should like to ask Doctor Carley whether there has been any great increase in the dairy industry in those counties during this decrease in malaria?

Dr Henry E Meleney Nashville Tenn—I wish to ask Doctor Carley whether he feels that the treatment of cases during this period was responsible for the great difference between the history index and the spleen and blood indices in his cases? It certainly is a factor in some communities.

Dr Carley (closing)—The rates shown in the graph represent the total number of blood and spleen tests made Some of the months were higher and some lower than the index as given The rate I gave was simply a moving picture or running rate for the entire period and that explains why our figures are somewhat lower than you might expect

The blood examinations were done mostly under the direction of Doctor Kemmerer and about 600 were done by Doctor Boyd I did roughly one third myself This is simply a picture of malaria as we found it in 1927 and 1928

We are not prophesying nor are we doing any more than giving the data found

In answer to Doctor Hackett's question there has been no perceptible increase so far as has been determined in Humphreys County in the past ten years there has been a slight increase in Sunflower County In an attempt to determine whether or not the presence of livestock in the vicinity of the houses whose inhabitants were examined had any bearing on the presence or absence of malaria we took a rather complete census of all stock near the residence of 2,000 colored rural inhabitants as the routine examinations were being made Our positive findings in that group were unfortunately very small so far as could be determined the presence of livestock near habitations played no part in the question of the amount of malaria in the inhabitants of these houses

As to whether or not treatment plays an important part in the discrepancies in history rate and spleen and blood rate I do not feel I am able to answer I have no doubt since the time of Doctor Bass work that chill tonic has played its part in cutting down the blood rate As to the spleen rate I do not know Quinin is very freely taken in the Delta Certainly it plays a part in the blood rate but whether or not an important part I do not feel equal to saying

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OBSERVATIONS ON THE MALARIA PROBLEM OF WEST TENNESSEE*†

By HENRY E MELENEY M D,
Nashville, Tenn,
EUGENE L BISHOP M D, C P H,
Nashville, Tenn
and
FRANK L ROBERTS M D
Trenton, Tenn

West Tennessee is that portion of the State lying between the Tennessee River on the east and the Mississippi River on the west In this region it has been believed from scattered observations that the malaria problem is essentially that of the alluvial valley of the Mississippi, and as such is a part of the malaria problem of the entire Mississippi Delta This problem is intimately associated with the flooding of low lands and in Tennessee would be expected to differ from the problem in the other Delta states only in the extent of the territory involved The relative amount of territory subject to overflow from the Mississippi River in the other Delta states as compared with Tennessee is shown in *Table 1* Tennessee contains only 1 5 per cent of the land subject to overflow in the Mississippi Delta For this reason both the malaria problem and the flood problem have attracted less attention in Tennessee than in the other states

In connection with the flood control program Tennessee will also probably receive little attention in the immediate future, for, although the Federal flood control program contemplates

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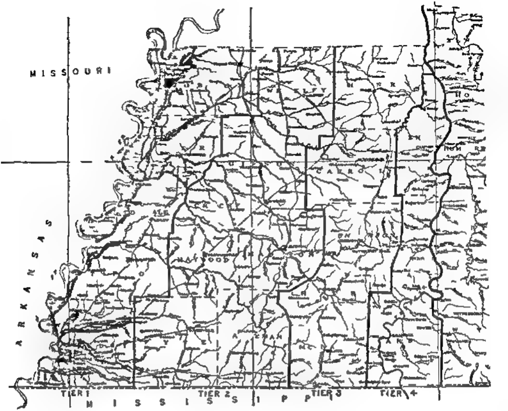
*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Second Annual Meeting Asheville North Carolina November 1[illegible] 15 1928

†From the Tennessee State Department of Public Health and the Department of Preventive Medicine and Public Health Vanderbilt University



Map 1
West Tennessee, showing the land subject to overflow during floods of the Mississippi River, and showing in three tiers the counties which have similar topographical conditions

the more efficient protection of territory already protected from floods it reserves for overflow and backwater all territory which is not at present at least partially protected The whole western border of Tennessee is included in this unprotected area This principle in the flood control program cannot be criticised since it is essential to the success of the whole project for controlling superfloods but it emphasizes the difficulty of future attempts to eliminate Anopheles breeding places in the unprotected alluvial valley in Tennessee

TABLE 1
The Amount of Land Subject to Overflow in Tennessee Compared with that in the Other Mississippi Delta States

State	Square miles subject to overflow	Compared with Tennessee
Illinois	65	1/7
Kentucky	125	1/4
Tennessee	453	1
Missouri	2 874	6
Arkansas	4 [illegible]	11
Mississippi	6 9 6	15
Louisiana	14 695	3
Total	9 90	66

The figures are taken from the map of the alluvial valley of the Mississippi from the head of the St. Francis Basin to the Gulf of Mexico published by the Mississippi River Commission in 1887 and last revised in 1907

Map 1 shows the portion of West Tennessee which is subject to the overflow of the Mississippi River This includes not only territory directly adjacent to the river but also the valleys of the tributary streams namely the Obion Forked Deer Hatchie Loosahatchie and Wolf Rivers as well as several smaller creeks and the region around Reelfoot Lake According to Ashley[1] the valleys of these tributary streams range from one fourth of a mile to four miles in width Their lower courses have a fall of only about a foot to the mile This rises to two feet in the middle courses and three or four feet in the upper courses On the Obion River for instance, the fall averages less than one and one half feet per mile as far as the town of

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By Henry E. Meleney, M.D.,
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†From the Tennessee State Department of Public Health and the Department of Preventive Medicine and Public Health, Vanderbilt University.

PURPOSE AND METHODS OF STUDY

The purpose of this study was to secure definite data with which to evaluate the malaria problem of the State and on which to base control activities The Department of Preventive Medicine of Vanderbilt University was invited to join the State Health Department in making the study

Lake County was selected as the headquarters for studying the problem and a laboratory was established at Tiptonville The work was started on June 26 and continued until September 22 1928

The plan of procedure included

(1) A study of the breeding places of *Anopheles quadrimaculatus* in Lake County

(2) Ascertaining the distribution of the adults of this species in relation to cases of malaria

(3) Surveys of homes and schools in Lake County in order to determine accurately the amount and distribution of malaria

(4) Collecting adult anophelines and their larvae in Obion Dyer and Lauderdale Counties

(5) Surveys of schools for malaria in these counties.

(6) Collecting adults and larvae of non malarial mosquitoes

Anopheline mosquitoes and their larvae were studied by establishing catching stations in each of the counties named These were visited weekly in Lake County by the laboratory staff and in the other counties by the county sanitary inspector All identifications were made by the Tiptonville laboratory Adult anophelines were also caught in certain groups of houses where malaria surveys were made

To determine the incidence of malaria surveys were made of school children and of certain communities The following procedure was carried out in most of these surveys Each person was questioned by a physician as to a history of chills and fever during this year or in the past two years A spleen examination was made by one of us (Meleney or Roberts) Children over twelve years old were usually excluded The person examined was placed flat on the back with knees drawn up and the examining hand placed directly on the abdomen except in the case of a few girls on whom it was necessary to make the examination through one thin garment If the spleen could not be felt with the child on his back he was turned on his right side Spleens were classified according to the method of Hackett[3] P representing the palpable spleens which did not descend below the costal margin and 1 2 and 3 representing those extending between the costal margin and the umbilicus No spleens were found which extended below the umbilicus Blood examinations were made by the thick drop method Except as indicated below they were stained and examined by Mrs Kiser of the Tiptonville Laboratory and were checked by Miss Aimee Wilcox of Birmingham Alabama Anopheles mosquitoes were searched for with a flashlight in the houses visited and their number noted

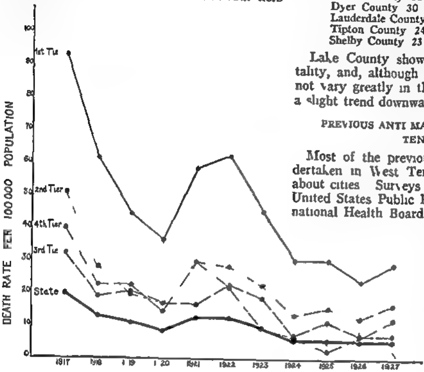
This procedure was carried out completely in three communities in Lake County on one farm in Lauderdale County and in schools in Obion Dyer and Lauderdale Counties In Lake County a blood survey of school children had been made in March 1928 under the direction of the United States Public Health Service This was repeated in September under the same direction and these specimens were all stained and examined by Miss Wilcox This survey covered practically all the schools of Lake County In the other three counties it was necessary to limit the surveys to fewer schools in order to secure the information not afforded by a blood examination In these surveys schools were selected from different parts of the counties in order to determine the distribution of the malaria problem

RESULTS

Anopheles Breeding—The entire area subject to overflow in the counties studied may be said to be suitable for the breeding of *A quadrimaculatus* This means that at different flood levels different places may meet the requirements of breeding places so that the studying of this problem requires observations over a long period of time and under all possible conditions The most striking fact brought out by our observations was that except in a few localities larvae could be found only in small numbers but that the total breeding area was very extensive Except on parts of Reelfoot Lake and in certain swamps and ponds there is very little growth of algae Algae are practically absent from the water in the overflow area Floatage consisting of twigs is the main protection which larvae have from top minnows which are present in large numbers in all overflow water The presence of these fish and the absence of algae are probably the reasons for the lack of more intensive breeding In regions

Obion which is about 45 miles from the river's mouth. This indicates that the area of back water in the valleys of these streams during flood is considerable and that in Tennessee the flood problem extends beyond the valley of the Mississippi River itself into the valleys of its tributaries.

Map 1 divides West Tennessee into four tiers of counties. All of the counties in Tier I border on the Mississippi except Obion which corresponds to the hilly portion of Dyer County. Tier II contains the middle courses of the tributary streams flowing west. Tier III contains the divide between the valleys of the Mississippi and Tennessee Rivers. Tier IV contains the tributaries and the valley of the Tennessee River.



Graph 1
The annual mortality from malaria in the four tiers of counties of West Tennessee and in the State of Tennessee as a whole for the years 1917-1927

Although mortality statistics are not an accurate index of the size of the malaria problem nevertheless they do indicate that the problem is most important in the counties bordering on the Mississippi and is present in other counties of West Tennessee. *Graph 1* shows the reported death rate from malaria since Tennessee was admitted to the Registration Area in 1917. It shows the death rate for the four tiers of counties of West Tennessee as compared with the rate for the entire State and demonstrates the relatively high rate in the Mississippi counties. For the years 1925, 1926 and 1927 the five Mississippi counties led the State in malaria death rates as follows:

Lake County 68 deaths per 100,000
Obion County 31 deaths per 100,000
Dyer County 30 deaths per 100,000
Lauderdale County [illegible] deaths per 100,000
Tipton County 24 deaths per 100,000
Shelby County 23 deaths per 100,000

Lake County shows much the highest mortality, and, although the differences in rate do not vary greatly in the other counties, there is a slight trend downward from north to south.

PREVIOUS ANTI-MALARIA WORK IN WEST TENNESSEE

Most of the previous anti-malaria work undertaken in West Tennessee has been in and about cities. Surveys by representatives of the United States Public Health Service, the International Health Board or the State Health Department have been followed by campaigns to stop Anopheles breeding. These campaigns have usually been financed jointly by the above named organizations and by the cities concerned. They have usually been followed by a marked decrease in the incidence of malaria in the community. The permanence of these results has varied somewhat with the subsequent activity of the local authorities in continuing the measures at first applied. Draining and oiling have been the chief measures employed. The most extensive and successful work has been done in Shelby County which contains the City of Memphis.

Screening of houses on a large scale as an anti-malaria measure was first undertaken in the State in 1927. A screen door factory was established in Dyersburg as part of the flood relief work of the American Red Cross and 475 homes in Lake, Dyer and Lauderdale Counties were screened. This work has been expanded in Lake County in 1928 and is reported by Fullerton.

shown a low blood index (2 per cent). The first two communities are each close to several sloughs, bayous and ponds in which quadrimaculatus larvae were found. The Madie district is farther from the river and contains one bayou which is usually dry and one which is continually flowing but has several pools along its course which breed quadrimaculatus. All three districts had a few houses well screened, many poorly screened and a few not screened at all. *Table 2* shows the results of these surveys. The Hathaway school was not surveyed at this time. It may be seen from the table that the evidence is nearly uniform in showing that malaria is an important health problem in these communities and that it is most severe in the regions most favorable for quadrimaculatus breeding.

In Lauderdale County a survey was made of a large farm whose owner had arranged for its screening by the County Health Department. This survey was made with the cooperation of the County Health Officer, Dr. R. B. Griffin. The purpose of this survey was to get an estimate of the amount of malaria previous to the employment of screening as a control measure and as a basis for the efficient treatment of cases. A second survey next year should show the combined effect of these measures. The farm is situated in the northwest part of the County (*Map 4*). It lies mainly in the bottom land but most of the homes are on the edge of the hilly region. The tenants are mostly negroes.

TABLE 3

Mala ia S v y f H n g Fa m Laud dale Cou ty Aug [illegible] 16 [illegible] 19 8

	N	Per Cent	White	C l
Homes visited	54		5	49
Hi t les tak n	2 5		7	08
P iti hi t i 1927	105	46		
P itv hi t i 1928	50	21		
Spl n x in ti ns	92			
P lpable	41	45		
Blood examinations	184		37	147
Positive bloods	41			
White	8			
Colored	3			
H s t i ing				
A quad im l tu	5	6		
La g t N l 1 h u e	0			
Av per po iti hous				

Table 3 shows that there is a high incidence of malaria among these people and that *A. quadrimaculatus* was present in most of the homes.

School Surveys.—In March and again in September blood surveys of the schools of Lake County were made under the direction of Mr. H. A. Johnson of the United States Public Health Service with the cooperation of the State and County Health Departments. We are indebted to the Public Health Service for permission to use the results of these surveys which are shown in *Table 4* and *Map 2*. These surveys were intended to indicate the minimum and maximum incidence of malaria for the year. The results show an increase of positive bloods among the colored schools from 14.7 to 23 per cent but among the white schools only from 10 to 12.2 per cent. It will be seen from *Map 2* that in the first survey the heaviest incidence of malaria occurred in the three white schools in the southern end of the County and that in the second survey all these schools showed a drop in incidence. Although the number of positives in any one school is too small to warrant definite conclusions it is apparent that the September survey did not show the expected increase of malaria. This is probably due to the fact that the Lake County Health Department distributed a large amount of quinin in these schools in late August and early September because of the large number of cases of malaria present in the region. Teachers in some of the other white schools also distributed quinin to their pupils. The probability that this treatment was responsible for the lack of increase in the blood index

TABLE 4

Malaria Pa a it R t Lake C unty School March and Sept mb 19 8

Wh t S hools	Numb Exami ed (March)	No be P iti (March)	Pe Cent P iti (March)	Numb E ami ed (September)	N mber Po iti (September)	P C nt P s tive (September)
B i	3	6	19	36	7	19
Phillip y	28	3	10	45	6	13
She p Ridge	30	4	13	18	2	11
C anvill	1	1	5	17	1	6
Proct City	26	3	12	4	5	[illegible]
Tiptonville	116	[illegible]	4	158	17	11
K f	34	6	18	25	1	4
Wynnb rg	31	3	10	63	5	8
M o l g	43	6	14	3	3	4
Madie	48	1		[illegible]		[illegible]
Ridgely	154	6	4	1 6	11	9
Chandl s Mill	[illegible]	1	3	2	7	8
R lf ot	17		12	16	2	13
P k s Mill	11	4	36	11	8	7
H thaway	[illegible]	3	35	31	7	23
Cott nw d	37	3	5	[illegible]	4	13
Owl H ot				[illegible]	6	27
T tal	687	[illegible]	10 0	1	88	12 2
C lo ed S h ol						
Phillipey				1	4	27
Proct City				9	3	10
T pt n ill	5	7	9	ot in		ion
[illegible] gan	15	0	[illegible]	7	0	[illegible]
Ke fe	27	6	19	n t in		io
Wy nbu g	2	3	14	15	4	7
M di	1	3	14	18	3	17
R dgely	58	14	4	38	14	37
Total	[illegible]	[illegible]	14 7	1 2	8	23 0

not subject to overflow, suitable breeding conditions were furnished by swamps pools in hill streams, *and ponds for watering cattle.* Fewer top minnows and more algae aided breding in these places After rains and in the latter part of the summer, unusual places were found to contain larvae Around Tiptonville, from the middle of July to the middle of September quadrimaculatus larvae were found in the following places in sloughs and bayous, in rain pools in street ditches, in Reelfoot Lake, in borrow pits along the highway, in a cistern with clear water and partly covered, in a rain barrel, in a five gallon can under a house, and in an unused cement watering trough

A punctipennis larvae were found mostly in streams but also in street ditches and in pools about towns

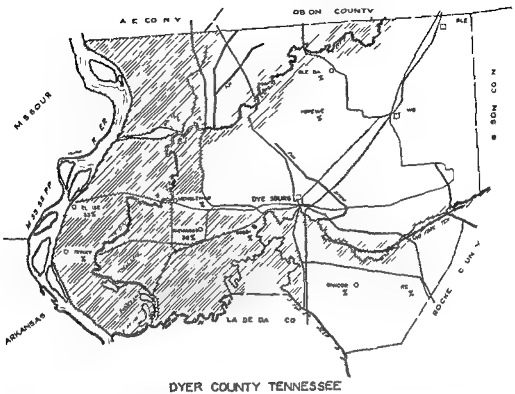
Adult Anopheles —The large number of adults of *A quadrimaculatus* which were found almost everywhere in the counties studied was in striking contrast to the difficulty of finding the larvae In the overflow area they could be found in or around most of the houses and in the hilly portions of the counties they were usually found at the catching stations Adults of *A punctipennis* as is usually the case were rarely found in or about human habitations

Community Surveys—In Lake County surveys were made with the cooperation of the County Health Officer Dr J P Moon of three communities in the southern part of the County to study the conditions associated with malaria Two of these communities Cottonwood and Hathaway were in the region flooded during 1927 and had shown a high malaria blood index (25 and 35 per cent, respectively) among the school children in March 1928 The third area, Madie had been partly flooded, but had

TABLE 3

Malaria Survey of Communities Lake County Tennessee July and August 19 8

DISTRICT	Homes Examined	Numb of Histori Taken	Malaria History No	Malaria History %	Numbe of Sple ns Examined	Enlarged Spleens N	Enlarged Spleens %	Number of Blood Specimens	Organisms in Blood N	Organisms in Blood %	Po itive Hist ry Sple n o Blood N	Po itive Hist ry Sple n o Blood %	Classification of Pos tive Spleen P	1	[illegible]	3	Location of District	Homes containing A Quadrimaculatus N	Homes containing A Quadrimaculatus %
Cottonw 1 Home	15	6	58	0	39	19	[illegible]	53	18	34	58	5	6	10	3	1	South bord of c nty land ubmerged during flood several slough and vate holes	18	87
Cottonwood Sch 1		9	19	[illegible]	27	18	6	30	15	50	27	90	5	9	4	0			
Cottonwood Total		105	7[illegible]	69	65	37	57	83	[illegible]	40	85	79	10	19	7	1			
Madi Hom	20	78	42	54	19	9	47	57	3	5	43	[illegible]	1	6		0	South c ntral portion land partly subme ged du ing flood On slough mostly d y One bayou th wate h l	4	20
Madi S h ol		55	39	71	42	26	6	51	13	26	43	[illegible]	9	11	6	0			
M di T tal		133	81	6	61	35	57	108	16	[illegible]	86	65	10	17	8	0			
Hathaway H m	8	39	[illegible]	80	16	5	[illegible]	56	10	[illegible]	33	85	3	2	0	0	South w t co n of county in b nd of Mi i ippi Riv Subm g d du ing fl od Slough and la g p nd alway con t ining wat	5	63



Map 3

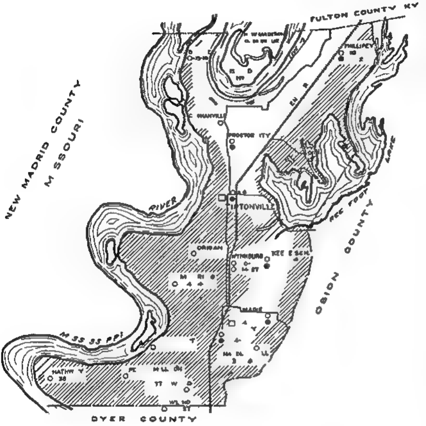
Dyer County Tennessee showing the land subject to overflow and the percentage of blood specimens positive for malaria in the school survey of August 1928. White circles represent white schools, black circles colored schools.

lower than in the worst schools in Dyer County. The incidence in all the other schools was comparatively low. *Map 4* shows that the bottom land in Lauderdale County is very extensive but the tributary rivers are on the north and south borders of the County and have not many large branches invading the County. This may explain the lower malaria incidence in the hilly portion of the County than in the hilly portion of Dyer County. This survey was too small, however, to determine accurately the severity of the malaria problem, and a blood survey of all the remaining schools is now being made.

In Obion County a school survey was made during the last week of August with the cooperation of Dr. C. B. A. Turner, County Health Officer. Eight white schools were selected and a total of 311 children were examined. *Map 5* and *Table 7* show the results of this survey. Obion County represents in topography the hilly portions of Dyer and Lauderdale Counties. Although it borders Reelfoot Lake on the west, very little of the adjacent land is subject to overflow. The Obion River flows through the eastern part of the County, but flows somewhat more rapidly here than lower down in Dyer County. The only school showing a high blood index was the Stovall school, situated near the Obion River. The history and spleen data indicate a moderate incidence of malaria also in the Reelfoot and Wayside schools, the two most western schools of the County to be examined. These data are comparable to those of the hilly portion of Dyer and Lauderdale Counties. A

is borne out by the fact that in the surveys which our own staff made in the Cottonwood and Madie schools early in August an incidence of 50 and 26 per cent respectively, were found This is in marked contrast to the incidence of 13 and 8 per cent found in the September survey Three other white schools in the southern part of the County also showed a similar drop in incidence

A school survey was made in Dyer County during the fourth week in August with the co operation of Dr O F Agee County Health Officer Six white and three colored schools were selected located mostly in the bottom land where malaria was known to be prevalent, but with a few in the hilly region Examinations of 411 children were made *Map 3* and *Table 5* show the results of this survey The County has an extensive area of bottom land in addition to the valleys of two tributary rivers The malaria incidence as shown by the blood survey and as emphasized by history and spleen records is highest in the portion of the bottom land which borders on the tributary rivers is somewhat less on the bank of the Mississippi and is considerable in the hilly portion of the County where large streams are present As there are no negro schools in the bottom land a racial comparison of the incidence there could not be made The Bonicord white and Tigrett colored schools however which are similarly situated, show equal blood indices We feel that the malaria problem in Dyer County is of practically as great importance as that in Lake County and deserves vigorous attention



LAKE COUNTY TENNESSEE

Map 2

Lake C unty T nn sh w ng the land ubject to ov flow and the per centages of blood pecimen p itiv for malaria in the school surveys of March and September 19 8 Whit circles represent white schools black circles colored chool

A similar school survey was made in Lauderdale County with the cooperation of Doctor Griffin during the second week in September Four white and three colored schools were selected, and a total of 183 children were examined If the 51 colored children on the Henning Farm between 6 and 16 years of age are included as another school the total is 234 *Map 4* and *Table 6* show the results of this survey The Ashport white school and the Henning Farm colored school are the only ones examined which are situated in or near the bottom land The malaria incidence in these schools was high but

TABLE 5

Malaria School Survey Dyer County T n es e August 4 19 8

SCHOOL	Num b L ni l	M l la Hi to y No	%	Larg d Spleen No	%	O gani ms in Bl l No	%	Po iti Spl Blood No	%	Cla ifi at n of Po iti e Spleen P	1	2	3	School Loc tion
Gl ndale whit	[illegible]	3	6	0	44a	14	0	3	6	5	9	5	1	10 miles N E f Dy r bu g Two miles from Obi n River
M glewo d wh t	8	7	[illegible]	18	6 b	14	5 b	5	100	6	9	3	0	9 miles w t of Dy rs bu g In bottom l nd on Obion Riv
Richwood whit	0	44	82	6	2	19	38	42	96	14		6	0	7½ miles S W of Dyers burg Low land near F ked Dee Riv r
H l l e wh t		4	95	33	6 c	19	33	56	98	12	10	5	0	On Mi issippi Ri er
Midway white	4	29	84	1	60d	15	3	4	96	9	10		[illegible]	On Mis i sippi River
Bonic d whit	48	3	52	0	42	7	2	34	4	11	8	1	0	8 mile S E of Dy s burg upla d
H pewell c l d	56	2	27	1	e	0	0	15	7	1	0	0	0	7 m les no th of Dyers bu g upland
Dobbin Gr d	3	18	49	6	36	6	16	19	51	2	3	40	0	4 miles w t of Dy b rg Low land near Fo ked De Ri
Tigr tt col d	44	18	42	n t	do	6	14							10 mil S E of Dyers bu g pl d

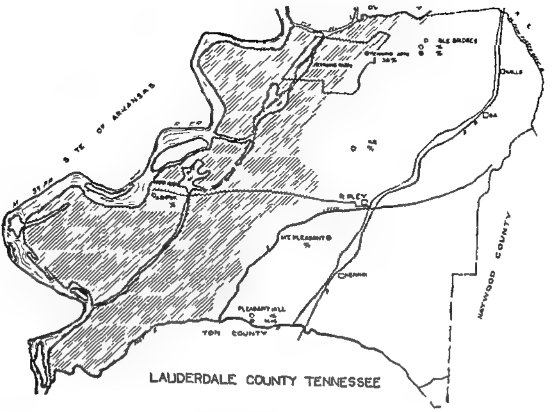
a Bas d on total of 45 On hild not xamined
b B d on t tal of 27 One child n t exami d
c Ba ed n total of 49 Eight hildren not ami d
d Bas d n total of 35 Ten hild n not ex min d.
e Ba ed n tot l of 5 Four child n not xamined

TABLE 6

M la a Sch ol Survey Laud d le County T n es Sept mb 6 13 19 8

SCHOOL	Number E an ined	M la ia Hi to y N	%	[illegible] l rged Spleen N	%	O ga i m in Blo d No	%	Po itive Hi tory Spl en o Blo d N	%	Cla ification f Po itive Spl n P	1	2	3	S hool Location
D [illegible] B dges white	4	11	46	10	42	2	8	13	54	5	3	1	1	N th pa t h ll reg n n c k
B whit	6	7	5	6	21 4	1	2 6	10	6	4	2	0	0	Central part hill egion
A hr t whit	38	7	71	23	61	9	[illegible]	[illegible]	87	11	9	2	1	On Mi is ippi Rive
Plea ant Hill whit	4	22	46	[illegible]	29	2	4	12	50	3	3	2	0	South part near Hatchi R r
Do ble B idg olo d	[illegible]	4	17	0	0	0	0	4	17	0	0	0	0	N th pa t hill gi n n a cr k
Mt Pl ant col ed	2	1	4	1	4	1	4	3	12	1	0	0	0	[illegible] uth c ntral part hill gion
Pl sant Hill l d	21	9	43	3	14	3	14	9	43	3	0	0	0	S uth part near Hat hi Rive

Thi b y a physi t w k N history n o gani ms in bl od
M ved ut of i h ttom this y



Map 4
Lauderdale County Tennessee showing the land subject to overflow and the percentages of blood specimens positive for malaria in the school survey of September 1928 White circles represent white schools black circles colored schools

more complete survey of the schools in Obion County should be made

Aestivo autumnal Malaria—Out of a total of 230 positive blood specimens examined by the staff of the Tiptonville Laboratory during this study 46, or 20 per cent, showed organisms which could be identified as *Plasmodium falciparum* Probably some others which could not be identified were also of this species This indicates that the malignant parasite is still a factor to be reckoned with as a cause of mortality in this region

NON MALARIAL MOSQUITOES

The control of the non malarial mosquitoes which feed on man is an important adjunct to anti malaria work in this Country because it encourages local support of this work and is often demanded more urgently than disease control *Table 8* shows the non malarial mosquitoes collected during the summer's work with their breeding places As far as we can determine this is the first systematic collection of the mosquitoes of Tennessee It is felt that such a collection is distinctly worth while both as a scientific contribution and as a practical measure

FUTURE PROGRAM FOR MALARIA CONTROL

This study has brought into sharper definition some features of our problem while others require considerably more attention before they are understood In the first place we now have definite data showing that there is a malaria problem in West Tennessee and that it is most acute in the bottom lands and along the lower

courses of tributary rivers Lake and Dyer Counties are the most seriously affected Estivo autumnal malaria is shown to be present in considerable amount, making the danger of mortality still a menace to be considered We now understand somewhat better the topography of the land in West Tennessee which is associated with the highest incidence of malaria that is the low lands along the tributary rivers, and regions rich in sloughs, bayous and flood formed ponds Drainage measures to improve the run off from these regions and provisions for maintaining what is accomplished by this drainage are undoubtedly indicated as the line of attack against quadrimaculatus breeding but the financing and supervision of such work is a problem in itself which cannot be quickly solved The carrying out of flood control measures and an economic demand for agricultural drainage are related to this problem and may help ultimately to solve it Relatively small collections of water or larger lakes or streams which are navigable may be treated by larvicides but most of the quadrimaculatus breeding areas included in this study are too extensive and too difficult to reach to be suitable for the use of larvicides Airplane dusting with Paris green is of course far too expensive for use over this large area These observations indicate that the breeding problem requires more study before we can determine what anti larva measures should be employed

We feel that county wide screening may bring a greater amount of immediate relief than any other single anti malaria measure Whether it will be possible to educate the people to understand and carry out real mosquito proofing of houses remains to be seen If screening alone can succeed in diminishing the incidence of malaria to a low enough level it may be that other measures will become less important Re surveys in screened and unscreened areas should provide considerable information on this question

ACKNOWLEDGMENT

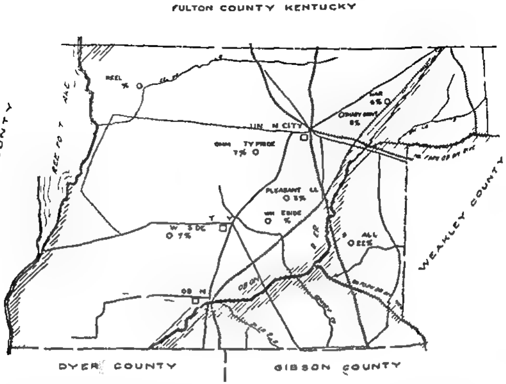
It is a pleasure to acknowledge the advice and assistance given during this study by Drs L L Williams and M A Barber and Messrs J A LePrince and H

TABLE 8

M squitoes Collect d in W st Tennes ee 1928

Mo quito	Breeding Places
1 A ophel quad ima ulatus	Slough lak pond ditch ra ly el ewhe e
2 An phele p n tip nis	Hill at am ground po ls of v iou ch ra t
3 A d s tri e i tus	Tree h l
4 Aede vexan	Clear unlit pool l r t ndi g water
5 C l x qui q fasciatu	Dirty t nd ng w te u u lly ar habit tions
6 C l x inh it itat r	imila to A quadrimac l tu
7 Man la p tu b	Larvae atta hed to vas ular r ots of sedge t edge of lakes and ponds
8 M garrhinus ept ntrionali	Tr e hol s
9 O th pod myia ignit r	T h l
P o phora ili ta	T mp ry p ol f cl a wat r
lumbiae	Dit h nd po ls
h ra cya ns	Dit h and l ghs
ignipen is	Dit h nd t mp ary pool
h w di	T mpo ary pool
	Tempo a y po l

In this study



OBION COUNTY TENNESSEE

Map 6
Obion County Tennessee showing the land subject to o erflow and the percentages of blood specimens positive for malaria in the school survey of August, 1928 White circles represent white schools black circles colored schools

TABLE 7

Malaria School Survey Obion County Tennessee August 22 30 19 8

SCHOOL	Number Examined	Malaria History 19 7 No	%	19 8 No	%	Enlarged Spleen No	%	Organism in Blood No	%	Positive History Spleen or Blood No	%	Classification of Positive Spleen P	1	2	3	School Location
Reelfoot	53	[illegible]	40 7	17	31 4	3	4 5		4	30	57	19	4	0	0	N W part hill c eek mil s Reelfoot Lake
Wayside	32	7	21 8	8	2o	1	37 5	2	7	16	50	1	0	0	0	Central part hill
Community Pride	68	14	20 6	9	13 2	15	2 5	5	7	2	3	8	[illegible]		0	Central part hills
White side	0	1	5	3	15	2	10	0	0	3	15	2	0	0	0	Central p rt hilly mi from Obion Ri
Pleasant Hill	40	7	17 5	5	12 5	6	†15	1	3	[illegible]	5	5	1	0	0	Central part hill mi from Obion
Stovall	3	7	30 4	6	6 1	9	‡41			[illegible]	65	6	2	1	0	E part hilly f om Obion
Shady Grove	2?	3	14	2	9	4	18	0	0	5	2	4	[illegible]	0	0	N E pa t hil from Obion
Harris	53	11	1	8	15	9	17	3	6	16	30	[illegible]	4	0	0	N E pa t Riv

Spleen examined in 31 only
†Spleen examined in 38 only
‡Blood exam ned in 22 only

MOSQUITO CONTROL IN LAKE COUNTY TENNESSEE A COUNTY WIDE SCREENING PROGRAM*

By HOWARD R FULLERTON C E†
Nashville Tenn

The preceding paper[1] has set forth facts concerning the mortality incidence particularly in Western Tennessee It has been clearly shown that Lake County has sustained a heavier mortality experience than any other section of the State Among the several control measures instituted in this as well as other countie was that of house screening

DESCRIPTION OF AREA

Lake County is situated in the extreme northwestern corner of the State is bounded on the west by the Missi sippi River on the north by Kentucky on the east by Reelfoot Lake and on the south by Dyer County The County is 122 square miles in area The width varies from three to eleven miles the length is approximately twenty miles A large number of sloughs are found in the County Several of these are of considerable size and contain water the year round furni hing ideal breeding places for mosquitoes

The farm land of the County is owned principally by about fifteen individuals The total number of property holders is approximately 125 It is stated that one person pays one seventh of the entire taxes of the County Farming is conducted on a rather intensive basis The vast majority of all farms is cultivated by means of wage hands and share crop tenants

According to the 1920 census there were 9 208 people in the County In the rural sections exclusive of the two principal towns namely Ridgely and Tiptonville the population eight years ago was 7 248 The increase since that time has probably not exceeded over four or five hundred The number of houses in the rural sections is estimated to be between seventeen and eighteen hundred

1927 SCREENING PROGRAM

During the year 1927 there were 165 house screened by the American Red Cros the State Department of Public Health and the United States Public Health Service

THE PRESENT 1928 PROGRAM

Early during the year the larger land owners in Lake County were invited to a meeting In attendance were several members of the County Court At this meeting the County Anti Malaria Committee consisting of five principal land owners was formed, a committee representative being chosen from each section of the County This Committee provided for a rotating fund of $600 00 and a ninety day credit allowance This was equivalent to approximately $2 000 00 total assets to be used by the Committee in the manufacture of screen doors A factory site in Tiptonville was selected and equipment furnished by the Red Cross during the 1927 campaign was installed

Detailed House Survey —A careful study was made of each residence in the County A careful record of each house showing location owner agent or tenant number and sizes of doors and windows was made This record also shows cost data and indicates whether the owner would be responsible for the hanging of the doors and tacking the screen on the windows or whether this responsibility would be delegated to the Committee

Manufacturing of Doors —The doors were patterned exactly in accordance with the design described by the United States Public Health Service

A door identification card was developed The data entered thereon was name of owner tenant or agent size of door and relative position of the door on the house and whether it would swing left or right This record carried the house number indicating the exact location of the house in the County This record was attached to the inner side of the top cross piece just as the door was started on its course of assemblage

Other Records —A cost sheet was developed and careful records kept as to the itemized cost of screening each house as well as the total for all houses screened This information in detailed statement form was not given to the owner except upon request Statements were rendered in the gross The average cost as shown in *Table 1* per screen door was $1 50 f o b factory

Labor Cost —It was found necessary to employ a competent shop foreman Under him was

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R d b f e N ti n l M l la C mmitt e (C fer n M la l) m ti g jointly with South rn M dic l As ociation Tw ty S e d An l M ti g A h ill No th Ca oli N mb 1 1 19 8

†F m the Divi i n f S t y E g i g St te H lth D p tm t H w d R F lle t n C E Di ct

A. Johnson of the United States Public Health Service, the cooperation of Mr. H. R. Fullerton of the Tennessee State Department of Health, and Drs. J. P. Moon, C. B. A. Turner, O. F. Agee and R. B. Griffin and the staffs of their county health departments, and the faithful and efficient service of Mr. and Mrs. W. J. Kiser of the Tiptonville Laboratory.

SUMMARY AND CONCLUSIONS

(1) A study of the malaria problem of West Tennessee, made in Lake, Obion, Dyer and Lauderdale Counties during the summer of 1928, showed a heavy incidence of malaria in the region which lies in the Mississippi River bottom and along the lower portions of tributary streams. Lake and Dyer Counties showed the heaviest incidence.

(2) Adults of *Anopheles quadrimaculatus* were found almost everywhere in the area studied. Breeding was found in varying amounts in regions subject to overflow and in some hilly regions, but was, in general, more difficult to demonstrate than was the presence of adults.

(3) Concerted measures should be undertaken at once to control malaria in the areas of high incidence. Mosquito proofing of houses is suggested as the measure most likely to produce prompt results. Where drainage is feasible it should also be undertaken.

(4) Further study of quadrimaculatus breeding is necessary in order to devise methods of control in extensive breeding areas unsuited for the use of chemical larvicides. A study should be made of the feasibility of cooperative efforts in malaria control, flood control and agricultural drainage.

(5) Twenty per cent of the positive blood specimens found in this study contained *Plasmodium falciparum*.

(6) Fifteen species of mosquitoes were collected during this study. Measures to diminish the incidence of the non-malarial mosquitoes will be a valuable adjunct to malaria control work.

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2. Fullerton, H. R.: A County-wide Screening Program. S. M. J., 3 39, April, 1929.

3. Hackett, L. W.: Unpublished report to the League of Nations on "The Organization and Methods of the Experiment Station for Malaria Control, Portotorres, Sardinia."

DISCUSSION (*Abstract*)

Dr. Paul S. Carley, Belzoni, Miss.—There are two points of interest that I might add in the discussion of this paper: first, the breeding of *Anopheles quadrimaculatus* in small containers seems to be limited to the Delta of Mississippi and Arkansas. Second, in regard to the difficulty of finding anopheline larvae: in areas like the one in which Doctor Meleney was working there are large water surfaces that will permit anopheline breeding. The difficulty in finding larvae seems to be due to the dilution of a large number of larvae over a larger area of water. In the Delta of Mississippi it is difficult to find larvae at any time of the year and almost impossible after November 1.

I should like to ask Doctor Meleney what differences were noted in colored and white spleen rates and in colored and white blood rates.

Dr. M. A. Barber, Greenwood, Miss.—We also find that *A. quadrimaculatus* in the Mississippi Delta is very adaptable as regards its breeding places. It seems that almost any water in this region at all fit for anopheles may at one time or another harbor *A. quadrimaculatus*. Various species of Anopheles show certain preferences in their choice of breeding places, but larvae of *A. quadrimaculatus* are found in a great variety of waters in the Delta.

Dr. Meleney (closing).—I do not believe that the absence of the rise in incidence of malaria shown in my paper by the blood survey of school children in Lake County in September was due to the screening carried out during the summer.

Doctor Carley asked about the relative incidence of malaria in white and negro schools, particularly in relation to splenic enlargement. We have the following data on white and colored schools similarly located:

Schools of Same Locality	County	School	Percentage Positive: Malaria History	Spleen	Blood
White	Dyer	Bonicord	58	[illegible]	15
Colored	Dyer	Tigrett	41		14
White	Lauderdale	Double Bridge	46	4	8
Colored	Lauderdale	Double Bridges	1	0	0
White	Lauderdale	Pleasant Hill	46	29	4
Colored	Lauderdale	Pleasant Hill	43	14	14

Not done.

We got a very distinct impression that the spleens were not as much enlarged in colored children as in white children.

HOUSE SURVEY AND RECORD SHEET

LAKE COUNTY ANTI MALARIA PROJECT

Dist. No ______ Road No ______ House No ______
Owner ______
Agent ______
Tenant ______
House measured by ______ Date ______

Doors

Number of doors ______ Date made ______
Date doors left factory ______
Is Health Unit to hang doors? Yes ______ No ______
Time hanging doors hours ______
Amount ______ Foreman's initials ______

Windows

Number of windows ______ Total sq. ft. screen required ______
Is Health Unit to furnish window screen Yes ______ No ______
Is Health Unit to put up window screens? Yes ______ No ______
Time hanging windows hours ______
Amount ______ Foreman's initials ______
Were window screens sent out with doors? ______
Yes ______ No ______ Sq. Ft. ______
Is house completely screened with 16 mesh?
Doors ______ Windows ______
Is other mosquito proofing satisfactory?
Yes ______ No ______ Remarks ______
Inspected by ______

Front

Number of chimneys ______
Number in family ______
Number had malaria, 1927 ______
Number had malaria, 1928 ______

Signed ______

Be sure and fill in each item at time work is done

REFERENCES

1. Meleney, H. E., and Bishop, E. L. Observations on the Malaria Problem of West Tennessee. S. M. J., 23 [illegible] April 1929.

2. Volume 42, No. 16, April 1927.

DISCUSSION (*Abstract*)

Dr. L. L. Williams, Jr., Richmond, Va.—It should be noted that before the screening work was commenced malaria indices were taken by history, spleen and blood. After the screening was completed similar indices were taken. The effort here made was good; it was as good as any county can expect from its health department. In subsequent years indices will be repeated. This study will not only indicate the measure of protection afforded by county wide screening, but will give added data on the relative efficiency of the three types of malaria index in measuring the rise or fall of the infection.

Dr. Henry E. Meleney, Nashville, Tenn.—I think I ought to say what I know is also in Mr. Fullerton's mind, namely, that the screening work in Lake County has only had its beginning. In the houses that are screened mosquito-proofing has not yet been thoroughly carried out. Unless that is done the screening loses a great part of its value. That is to be done during the winter and next summer we are going to be able to measure by means of surveys the effect of the screening.

OIL MIXTURES AND OIL EQUIPMENT FOR ANOPHELINE LARVAE CONTROL OF IMPOUNDED AREAS*

By L. M. CLARKSON †
Atlanta, Ga.

Since little more than a quarter of a century ago, when oil was first used for control of mosquito larvae, very few data have been presented on the value of various grades and mixtures of oil for this purpose. There has also been a limited understanding of the effect of various oil films upon larval life. Until recent years oils for this purpose were used almost exclusively on small areas of water not necessitating the factor of economy. For such use there has been an inclination to accept almost any distillate of crude petroleum of light specific gravity which would spread well on the water.

In recent years it has become necessary to control mosquito breeding on large hydro electric impounded areas. Due to the large quantity of oil required and the expensive oiling equipment necessary, there has developed a realization of the necessity for definite oil formulae as well as standard equipment for application. On account of the extensive development of hydro electric power in the Southeast, where malaria is prevalent, there are few sanitary problems of greater importance than control of production of anopheline mosquitoes on impounded waters.

The following information represents only an experiment and is presented as a step to what should be accomplished by further experiments with various portions of certain grades of oils and the mechanical equipment for application. The experiment was in connection with an impounded area of about 7,000 acres. The area was first cleared of all vegetation. Before oiling was begun it was necessary to provide equipment, material and personnel for oil spraying.

At the start of the work a mixture of fuel oil and kerosene was used in a number of different portions, 25-75, 30-70, 40-60, and 50-50, none of which was found to film effectively or have

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placed a number of colored laborers This however, was not a satisfactory arrangement, high school boys being substituted for these later This new arrangement proved to be much more satisfactory On the basis of their ability to produce ten finished doors daily the boys were paid $2 00 per day each the labor cost per door, therefore, being 20 cents

Other Costs —Cost of survey of correct hanging of doors, attaching window screening and other mosquito proofing periodic inspection and instruction as to the proper use of the screens were not added to the owner s bill The Committee did not assume responsibility for delivery of the doors the owner being notified promptly on the completion of his order for doors

Results —*Table 3* sets forth in detail the number of houses screened during 1928 in Lake County also the number of schools churches camps and the like in which screening was effected Much use was made during the campaign of the two weekly newspapers of the County Each of these carried in almost every issue some data concerning the advantage of screening and through this as well as other methods, much interest was aroused in the County

Not only were the screens properly installed but the members of the family carefully advised as to the proper use of these screens The freedom from mosquitoes as the result of the proper installation and use of the screens was one of the principal aids toward the expansion of the program

CONCLUSIONS

(1) In a county wide screening program where property owners are to pay the cost too much attention cannot be paid to details item costs education, and quality of work done

(2) The season's needs should be anticipated as closely as possible and the wholesale company from whom you expect to buy materials informed thereof

(3) A stock inventory should be taken daily

(4) Doors of a design of known strength and durability only should be used

(5) If additional mosquito proofing is necessary this phase of the work should be vigorously prosecuted until it is completed at every home

TABLE 1

ESTIMATE OF COST OF A SCREEN DOOR

Average Door 3 x78

Galv iron corner bracing—24g—30 x96 @ [illegible] 26—$	095
Screen wire 15 1 sq ft @ 3c	434
Lumber 7 63 bd ft & $ 2 50 per m and 0 3 m casing strips @ $ 35 m	564
Corrugated fasteners	005
Labor	00
Hinges @ 10c pair	100
Screws @ 20 gross	016
Tacks @ 1 o lb	010
Nails @ 6c lb	009
Springs No 5 @ 4c	040
Pulls and screws @ 2c	020
Freight on screen wire and hardware	007
	$1 60

The e items include 5% for waste

TABLE 2

MATERIAL AND COST DATA

Doors

Doors average in size 32 x 8
Number of doors pe house ([illegible] houses) 2 8

Windows

Number of windows per house (average 100 houses) 4 76
Average amount of wire per house for windows (includes % for waste) 59 5 sq feet
Average amount of wi e per window 12 5 sq feet

Average Cost Screening One House

Cost tacking wire on one window (17 houses)	$ 115	
Cost of tacking wire on one house—4 76 windows		[illegible]
Cost of wire for one window @ 0 3c	375	
Cost of wire for one hou e—windows		1 78
Cost one door at factory	1 50	
Cost doo s for one house—2 8 doors		4 0
Cost of hanging one door	0 8	
Cost of hang ng doors one house—2 8		[illegible]
Transportation of doors		
		$6 [illegible]

TABLE 3

SCREENING IN LAKE COUNTY TENNESSEE TO NOVEMBER 1 [illegible] 8

Doors

Doo s made for homes [illegible] Lake County	15
Doors made for Camp Markham (Boy Scouts)	167
Doors made for Laude dale County	167
Doo s r screened for Lake County	68
Doo s made for comm rcial establishments	4
Doo made for chu ches	2
Doo s made for county school	36
Total doors	2457

Screen Frames

School hou e window frames	211
Frames for tent Camp Markham	144
Chu h s	8
Hou es	7
	3 0

Homes Sc eened

Hom s screened Lak County 1928	880
Homes screened 19 7 Lake County	165
Total	1045
Estimated per nt of Lake County homes now screened	59 7

PRACTICAL APPLICATION OF PARIS GREEN AS A LARVICIDE FOR ANOPHELES LARVAE ON AN IMPOUNDED LAKE IN ALABAMA*

By D G GILL M B D P H †
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C C KIKER
Montgomery Ala

and

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Birmingham Ala

Petroleum products chiefly kerosene and black oil have had almost universal application as a larvicide in the control of anopheline mosquito breeding on newly impounded waters in Alabama The use of this larvicide has generally met with success on lakes impounded strictly in accordance with the State regulations governing impounded waters The principle requirements are that the basin be cleared before impounding and the waters stocked with gambusiae

Within the last few years no less than ten major lakes have been impounded in the State The efficiency of oiling methods and equipment has progressed rapidly since the first larvicidal control work of note was undertaken on Lake Mitchell of the Alabama Power Company in 1923

The high pressure pneumatic method of oil spraying was developed in 1923 on the Golden Bridge Pond of the Houston Power Company To meet certain conditions which were not favorable to this method a machine was developed on Lake Martin of the Alabama Power Company which delivered a large stream of water into which was introduced the required amount of oil the oil water method

Conditions Leading to the Use of Paris Green on Lake Martin—Notwithstanding the rapid improvement in methods of oiling it developed during the season of 1927 that certain areas on Lake Martin were very difficult if not impractical to control through oiling

The basin was cleared prior to impounding However some two years time was required for clearing operations which gave rise to a considerable second growth of sprouts bushes and weeds before impounding could be accomplished Some of the most important areas were improved by subsequent reclearing

Impounding was begun early in 1926 proceeding slowly during the breeding season of 1926 and up until the latter part of the 1927 season The slowly rising water into territory previously unflooded gave rise to conditions particularly suitable for *A quadrimaculatus* production *en masse* That portion of the shore line which was more or less open was fairly easy of handling There were however certain larger flat areas most difficult to reach and oil effectively In addition algae were found to be growing profusely in the wind protected areas which added materially to the difficulty of reaching the larvae with a toxic oil film

The control season ended abruptly during the latter part of August when use of the stored water for electrical development was begun With the lowering of the lake level a sharp decrease in adult *A quadrimaculatus* station counts resulted After three weeks practically no adult mosquitoes could be found

In view of conditions encountered during the season of 1927 it was agreed between the Company and the State Board of Health that the use of paris green would be attempted on certain areas during the season of 1928 Oiling equipment would be used where effective

Selection of Equipment and Material for Paris Green Application—Literature on the subject of paris green was studied carefully Barbour[1] Boyd Hackett[3] King[4] Williams[5] LePrince[6] and others reported successful use of paris green as an anopheline larvicide The application had been accomplished by means of a dust cloud produced on the windward side of the area This floated over the breeding ground and deposited paris green Distribution has been by hand by hand dust guns and by airplane The paris green had been mixed with some inert dust in varying proportions from 1 to 50 per cent depending on the method and rate of application From one half to one pound of paris green per acre had been used for successful destruction of larvae

*R p t to N tio l M la a C mmittee (C f renc n M l i) m ti g o j i tly with South rn Med cal A soci ti Twe ty S o d Annu l M ti g Ash v ll N th C l a N mb r 12 15 19 8
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†Dir ct Bu au C mm cabl D seas C ntrol Alab ma St t Bo d f H lth.

‡Assi t nt Sa itary E gi Alab ma Stat Bo rd f H lth

††S p rvi It tl n a d Mal ia C t ol Al bama P w C mp y

the required toxic effect Then 1100 gallons of transil oil was acquired, which proved to have all of the qualities for spreading as well as a slight toxic effect and when mixed 50 50 with kerosene gave excellent results (Transil oil is a very highly refined oil used in transformers Even the waste is of too high value to be economical) When the transil oil was exhausted oil was again used and the breeding curve took an upward slant Then there were secured from the Standard Oil Company samples of plain black oil paraffin oil and distillate oil The best results were obtained with a mixture of 20 per cent black 20 per cent kerosene and 60 per cent paraffin oil the black oil for maintaining the film the kerosene for toxic effect and the paraffin for spreading The presence or absence of breeding was checked by a dipping crew which followed the spray crew three days later checking the places where breeding had been heavy

While fuel oil was being used control was only fair When transil oil was used the breeding was reduced about 75 per cent On return to fuel oil the breeding increased When paraffin oil was used there was almost complete control after the second round The checking crew then checked one day ahead of the spraying and their findings showed larvae too small for identification and in most places no breeding at all

The following shows the cost of malaria control work for the year 1927

Total cost for equipment	$7 688 00	
Take 20 per cent for the year 1927		$1 533 00
Total cost of labor for five months		6 400 00
Total cost of spray oil gas and supplies		1 979 20
Total		$9 912 20

The total length of the shore line was 156 miles and 22 oilings of 3½ days each were made for the season

Six hundred fifty five and one half gallons of oil were used for each round of oiling

The average width of the oil film was fifteen feet

COST OF OIL

The number of acres oiled per round was 283 5 and amount of oil per acre 2 5 gallons At a cost of 11 cents per gallon for oil this gives a cost of 27 5 cents per acre per round of oiling or $6 05 per acre per season

The cost of oil per mile of shore line per round was 46 2 cents, or $10 16 per mile of shore line per season

GRAND TOTAL COST

The grand total cost per acre per season was $35 00

The grand total cost per mile of shore line per season was $63 34

Because of the great length of shore line necessitating a supply barge and operation far from base and liberal allowance for elaborate equipment, the unit cost figures herewith should be considered as maximum rather than minimum On smaller areas where the supply barge could be dispensed with and supply stations established on the shore this unit cost could no doubt be considerably lowered

As an appendix there is herewith attached detailed cost of equipment, labor and supplies

EQUIPMENT

1 supply barge 40x18x4 6 draft	$600 00
1 propelling engine 26 H P	150 00
1 Worthington feather valve air compressor	325 00
1 novo vertical gas engine 9 H P	275 00
1 air receiving tank 250 lb pressure 42 x96	230 00
4 82 gallon gas tanks	100 00
8 2½ H P Johnson outboard motors	1 008 00
Repair parts for Johnson motors	600 00
5 spray boats 16 x3 9 beam each equipped with 1 82 gallon oil tank spray nozzle and metal hose	300 00
	5 588 00
2 motor boats 1 25 ft and 1 0 ft inspection etc	2 100 00
Total	$7 688 00

LABOR

1 supervisor at $150 00 per month	150 00
1 assistant supervisor at $100 00 per month	100 00
5 operators at $80 00 per month	400 00
3 operators at $70 00 per month	210 00
4 laborers at $2 50 per day (per month)	240 00
1 mechanic (part time) $6 00 per day 30 days	180 00
Per month	$1 280 00
For season	6 400 00

SUPPLIES

14 420 gallons of spray oil at 11c per gallon	$1 586 20
960 gallons of gas at 20c per gallon	193 00
Tools and miscellaneous supplies	200 00
For year	$1 979 20

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Thi w k wa rri d ut by th Alab ma Powe C mp ny p ti g with th Al b ma State Boa d f H lth Th x im nt wa att mpt d t the sug g ti n f M G H Ha l hu t Chi f S nit ry En gi Alab ma Stat Bo rd f He lth wh cri m ha b available a d most h lpful at all tim

†D to Bu u Communi ble D e C nt ol Alabama St te Bo d f He lth

‡A s t nt Sa tary E gin er Al b ma State Bo rd of H lth

††S p rvi Sa it tion and Mal ia C nt ol Ala bama P w C mp y

It was realized that the methods of distributing dust which had been used in the past at other places would not be applicable on Lake Martin. Hand methods of distribution would be inadequate. The use of airplanes was not considered economically sound or adaptable to the work due to the basin characteristics. There were hundreds of bights of varying lengths and widths, enclosed by steep rolling hills. The breeding areas were widely separated over a large territory. The shore line was ever changing.

This is the largest lake in the State. A conception of its extent may be had when it is stated that at maximum elevation an area of 40,000 acres is submerged, forming a shore line estimated at 700 miles. The project might be termed a storage reservoir, water being impounded during the rainy season and used during the dry season.

Power dusters had not been used previously for this type of work. Various makes were tested early in the winter of 1928. Experimental equipment was mounted on a boat and tried before the breeding season. It gave full promise of success. For handling areas which could not be reached by the power machine hand dusting would have to be used. Various types of hand dusters were therefore tried out.

After considering the merits and adaptability of three makes of power machines the Niagara F 27 machine[7] with an 8 horsepower engine, was selected to be supplemented by the Fiasco knapsack hand dusters.[8] The fan blower type hand machines produced the more suitable dust cloud, but were more tiring to operate than the knapsack bellows type.

Following the preliminary study the manufacturers of dusting machines, dusts and paris green were conferred with in reference to the character of the dust. Road dust, kaolin, powdered soapstone and lime were considered. After investigating costs and adaptability it was decided to use soapstone rather than some of the other carriers for the following reasons:

(1) It was available in any quantity on short notice.

(2) Uniform in quality.

(3) Most economical under the conditions.

(4) Could be obtained from the manufacturer, machine mixed with paris green, insuring uniform mixing.

(5) Appeared to float and carry in a dust cloud with the paris green. Location of the settlement of the dust cloud would therefore, be a true indication of where the paris green had been applied.

(6) Least absorbent.

(7) Being floatable, hope was entertained that it would mechanically assist in keeping the paris green afloat for a longer time than might be secured through use of a readily sinkable dust.

A contract was later given to a chemical house[9] in Birmingham for furnishing the paris green soapstone mixture in 50 pound paper sacks.

The paris green[10] to be used was guaranteed to contain a minimum of 50 per cent arsenious oxide ground to such fineness as to pass a 200 mesh sieve.

Application of Paris Green as an Anopheles Larvicide on Lake Martin.—Routine inspection for larvae and adults was begun on May 1. Due to heavy rainfall the lake became completely filled before *A. quadrimaculatus* production began. With some few feet fluctuation it remained practically full throughout the summer. From a standpoint of mosquito production the shore line improved throughout the season. Conditions most favorable for anopheline breeding as encountered in 1927 did not obtain to such an extent in 1928 except for possibly a short period during the earlier part of the season. Any conclusion drawn from subsequent observations must necessarily be considered along with the fact that the work was done on a lake sufficiently clean, with few exceptions, for control through oiling.

During the first week in June sufficient *A. quadrimaculatus* larvae were found to warrant the beginning of control operations. The dusting unit was assigned sections of the shore line which had previously proved most difficult and expensive of control through oiling. The complete unit consisted of one power duster mounted on a boat propelled by an outboard motor. Two men were required for its operation. Accompanying this power duster was a small boat carrying the foreman of the unit and two laborers equipped with hand dusters for treating areas which could not be reached by the power machine.

Shortly after the dusting unit had been placed in service observations were made on its operation and effectiveness. Records of previous work done elsewhere gave one pound of paris green per acre as sufficient for complete larvae destruction. The first check showed that a 1 per cent mixture did not contain sufficient paris green to reach all areas with one pound per

acre at the rate of dust application adopted As close as might be estimated, a 5 per cent mixture appeared suitable In this connection it might be stated that it is very difficult to estimate the average amount of dust reaching an irregular area With the slightest breeze the dust would often be carried far beyond the intended points of application In fact the chief difficulty encountered in the work was to get settlement of the dust where desired

Areas were checked before and after dusting and mortality was found practically complete in some areas while in others larvae reduction was not more than 50 per cent The dust was tried in pans and found to kill practically 100 per cent in less than six hours Areas were selected and the dusting continued until there remained no doubt that an amount of paris green in excess of one pound per acre had been applied Uniform mortality did not result in all places

Study and Experiments to Determine Reasons for Non Uniform Larvae Reduction on Lake Martin Through Use of Paris Green—As an explanation of the failure to secure uniform results the following possibilities presented themselves

(1) That the paris green being used was not sufficiently toxic In other words the arsenic oxide content was below that guaranteed and found essential for such work

(2) That the paris green was not of the proper grade as to size of particles

(3) That the powdered soapstone used as a diluent remained on the surface and was perhaps being eaten by the larvae which lessened their chance of obtaining a lethal dose of paris green

(4) That an insufficient amount of paris green was being applied to certain areas

(5) That the paris green through sinking quickly or being carried away by wind currents and wave action or for other reason was not being held in contact with the larvae for a sufficient length of time to enable them to obtain a lethal dose

As to the possibility of the paris green's not being sufficiently toxic the dust was applied to larvae in pans with almost complete mortality in about two hours A sample of the paris green was submitted to Dr B B Ross State Chemist who found the specimen contained 52 36 per cent arsenic trioxid (As_2O_3)

Boyd reported that the color of an unsatisfactory lot of paris green purchased and used in South America was pale green while that of a satisfactory lot purchased later and used successfully was a deep emerald green in color The paris green used on Lake Martin had the deep emerald green color

Notwithstanding these reports and observations on the quality of paris green being used it was decided to compare it with the product from other manufacturers by actual field tests records of which are given on tabulated form on another sheet

The size of the grains was tested in several ways Of several samples given the size test recommended by Hackett[3] as representing a satisfactory paris green all passed completely through the 200 mesh sieve Samples given the cylindrical tube test as representing a satisfactory paris green as to size of particles conformed to the test This test is quoted as follows

> A rough criterion is the tendency of too fine a powder to clump in small masses when rotated in a test tube The grains of a coarser powder will roll separately one over the other without agglomerating and in a small tube will assume a plain surface to the angle of rest

The paris green from four manufacturers was also examined under the microscope The particles in all appeared to have considerable variations in size In a single sample would be found particles ranging in size from very fine to very coarse Subjecting a sample to prolonged grinding in a mortar seemed not materially to increase the fineness of the particles as observed under the microscope

One manufacturer[11] whose product (brand C given in the tabulation) is reported to have had wide use on such work in the past stated that his paris green was ground sufficiently fine to pass almost entirely through a 300 mesh sieve

The record of a test using paris green passing a 130 mesh sieve and retained on a 200 mesh screen is given in the tabulation of experiments

As to the proper characteristics of the diluent it might be stated that highly satisfactory results were reported by Williams[6] LePrince[4] and others through the use of paris green and soapstone in the airplane distribution work at Quantico and Bamberg However a much greater per cent (minimum 25) was used in the airplane work than was used on Lake Martin (maximum 5 per cent)

Comparative tests were made on larvae under natural conditions to arrive at the possible difference in effectiveness using soapstone and a readily sinkable carrier as kaolin or hydrated lime The record is given in the tabulation of experiments In 1922 Barbour and Hayne[12] advised against the use of flowers of sulphur stating that because so large a portion of it re-

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A contract was later given to a chemical house[9] in Birmingham for furnishing the paris green soapstone mixture in 50 pound paper sacks.

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sulting while in the most successful tests the paris green particles appeared to remain afloat and uniformly distributed The latter condition is evidently ideal for complete larvae destruction

The paris green being used on Lake Martin compared favorably with the products from three other manufacturers No material difference was observed in the comparative tests using a readily sinkable diluent dust and one that floats A Root hand gun with high speed fan blower was used for dust distribution in the tests a tabulation of which is given as follows

During the work so far as is known no harmful effects of importance resulted to man animal or fish In addition to the ordinary precautions taken the workers were supplied with

(3) There developed certain areas in Lake Martin in 1927 where oil failed to control breeding

(4) Following the agreement to use paris green in 1928 decision was made to apply the dust through use of a power duster mounted on a boat The machine was to be supplemented by knapsack hand dusters Powdered soapstone was selected as a diluent after considering hydrated lime kaolin and road dust

(5) After preliminary trial a 5 per cent mixture of paris green was found more suitable for general application than a 1 per cent mixture

(6) Inspection following the applications of paris green showed that larvae mortality was not uniform in all places

(7) A series of tests and observations was

Numbe f E p m t	LOCATION AND CHARACTER OF BREEDING AREA	B d P G	P d P I G A	T m f Appli	C Di t	P t G e P t M xt b W ght	A P mp T t	Check B f Appli t: N mb D p	Check B f Appli t: T t l L	Check Afte Appli t: H m El p d	Check Afte Appli t: N mbe D p	Check Afte Appli t: T t L L	P t M rt l ty +: I P	P t M rt l ty +: In Breed g A a
1	Lak Mart Brush Weed	A	1	9 A M	So p to e	1		60		8	60	2		97
2	Lak M t B h Weed	B	1	10 A M	S p to e	1×		60	80	8	60	1		97
3	L k M rt n Bru h W eds	A	1	10 A M	S p tone	1		50	100	5	50	4		[illegible]
4	D tch d d eg tat n	B	1	3 P M	S p to	1		10	44	20	10	5		86
5	D t h dead g tat	A	1	3 P M	S p tone	1		10	59	24	10			68
6	D tch dead get t n	B	1	4 P M	K l Dust	1×		10	89	24	10	17		81
7	D tch de d eg t tion	B	1	4 P M	Kaol n D t	1	y	10	22	24	10	10	100	55
8	D tch d ad eg tat	A	1	5 P M	Kaol D t	1		10	50	4	10	9		8
9	D tch dead get ti n	A	1	3 P M	So p t	5		10	48	24	10	18	95	0
10	D t h de d eg tati	A	1	2 P M	S p to e	5	yes	[illegible]	206	24	80	68	6	I
11	D t h dead tat n	A	2	3 P M	S p t	5	yes	20	1 6	24	80	112	96	86
12	D t h d ad g t ti	C	1	3 P M	S p t	5	yes	20	[illegible]	[illegible]	80	221	100	10
13	D t h d d eget ti n	C	1	7 A M	S p t	5		[illegible]	444	24	80	6		[illegible]
14	D tch d d eg tat n	D	1	8 A.M.	S p t	5	ee	30	321	4	80	06	100	56
[illegible]	D tch d d eg tat	C	1	9 A M	S pst	[illegible]	n	30	6	24	[illegible]	3 9		48
[illegible]	D tch dead eg t t	A	2	1 A M	S p t	50		[illegible]	258	[illegible]	80	1 5		58
17	Small P d, log g ase	C	1	4 P M	Hyd. Lim	15	yes	80	104	6	80	[illegible]	100	100
18	m ll P d weeds A g	C	1	4 P M	S psto	15	yes	2(	93	[illegible]	[illegible]	2	10(	98
[illegible]	Sm ll P d d d l es	[illegible]	1	10 A M	Hyd. L me	15	yes	10	62	6	10	1	100	96
20	Sm ll P d heavy Alg	[illegible]	1	10 A M	S p t	5	y	10	8	6	20	0	100	100
21	Sm ll P d h vy Algae	A	1	11 A M	Hyd. Lime	15	yes	2	[illegible]	10	0	0	100	100
22	Sm ll P d h vy Al	A	1	11 A M	So p t	5	yes	10	69	6	20	2	100	97

Parl Gre n grad d t pa s 330 m h en nd be tai d on 00 m [illegible] s e
+ Sm ll fi t t g l rvae t ted
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simple respirators[14] which were used only when they were in the dust cloud

SUMMARY AND CONCLUSIONS

(1) With few exceptions petroleum products have had successful application for control of anopheline larvae on impounded waters in Alabama which were impounded according to the State regulations

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made in an attempt to ascertain the reason for non uniform results with the following findings

(a) The paris green being used on Lake Martin was satisfactory as to chemical content of arsenious oxide

(b) The fineness of the paris green appeared satisfactory It was found however that paris green retained on a 200 mesh sieve was entirely too coarse for larvicidal work From our observations it is thought that a more limiting specification on paris green as to coarseness would be that it pass almost entirely through a 300 mesh sieve No information was obtained

mained floating it was ingested with the paris green which was then too much diluted

It is difficult to determine accurately the amount of paris green which is applied to irregular areas as found in field practice However judging the application on the lake by comparison with the application made to measured areas it is estimated that the average dosage was one pound per acre although some areas may not have received so much

The possibility of the paris green s not being held in contact with the larvae under the conditions appeared to be chiefly influencing the results A review of the literature showed that previous applications of paris green had been almost exclusively in areas covered solidly with brush trees and aquatic growth The breeding areas in comparison on Lake Martin were more or less open and subject to agitation with little of the aquatic growth found in some old ponds and natural bodies of water Again after the dust cloud had settled on the surface of the water in these more or less open areas it was very often blown aside by wind currents Added to this was the wave action from the distributing boat which undoubtedly increased the possibility of the paris green s being sunk or drifting aside before it could be ingested by the larvae

In an effort to obtain an answer to some of the possibilities considered which were pressing a series of experiments were made in the vicinity of Montgomery and elsewhere[18]

A number of the tests were made on an old ditch near Montgomery where heavy anopheline breeding was found This ditch was located in a swamp and averaged some twelve feet in width Water stood to a depth of about two feet The water surface was unusually clean except for a thin rim of vegetation leaves and floatage along the edges The flow of water was practically negligible Twenty fourth stage larvae were taken from the ditch about the time the tests were begun and identified as follows 1 *A quadrimaculatus* 12 *A punctipennis* 7 *A crucians*

The alkalinity of the water by the methyl orange test showed 12 parts per million

In some of the tests microscopic examinations were made on the dust films taken from the water s surface In all cases a greater or equal density of paris green for any given length of time was found in films taken from the pans than was found on films taken from the breeding areas

In experiment No 11, given in the tabulation a mortality of 96 per cent resulted in the accompanying pan test with only a 36 per cent mortality being observed in the breeding area In this particular experiment dust films were taken at thirty minute intervals and examined under the microscope for paris green The paris green distributed over the area sank rapidly with a greater percentage going down immediately following the application On the other hand the paris green on the surface of the water in the pans appeared undiminished after two hours Only one particle of paris green per microscopic slide could be found in the film from the breeding area after this length of time This observation offers an explanation for the usual greater mortality in the pans over that found in the breeding area The influencing factor appears to be the variable water tension holding the particles afloat This tension evidently varies with different bodies of water In the successful experiments Nos 17, 18 19 and 20, practically equal densities of paris green particles were observed on the surface of the water in the pans and on the breeding areas at all intervals of time up to two hours In other words, the paris green applied to these areas remained afloat for a sufficient length of time for the larvae to obtain a lethal dose Our observations in these experiments indicate that with an increase in the density of floatage and growth the water tension increases with a corresponding increase in the probable effectiveness of paris green

During the tests it was noted that in some cases where a readily sinkable diluent was used as kaolin or hydrated lime the remaining paris green congregated in islands or groups of particles This was noted particularly in test No 7 where 100 per cent mortality was obtained in the pans with only 55 per cent mortality in the breeding area In test No *19* hydrated lime was used with practically 100 per cent mortality in both the pans and breeding area In this area the paris green particles appeared to rest where they had been uniformly deposited on the surface The water was agitated purposely to break the film but it promptly closed again leaving in the end an unbroken film of paris green of apparently equal distribution

The test showed that there is quite a difference in the bahavior of paris green particles applied to various water surfaces In some instances the particles sank rapidly with only a small per cent of the larvae obtaining a lethal dose In other instances the particles collected in groups with incomplete larvae mortality re

sulting while in the most successful tests the paris green particles appeared to remain afloat and uniformly distributed The latter condition is evidently ideal for complete larvae destruction

The paris green being used on Lake Martin compared favorably with the products from three other manufacturers No material difference was observed in the comparative tests using a readily sinkable diluent dust and one that floats A Root hand gun with high speed fan blower was used for dust distribution in the tests a tabulation of which is given as follows

During the work so far as is known no harmful effects of importance resulted to man animal or fish In addition to the ordinary precautions taken the workers were supplied with simple respirators [14] which were used only when they were in the dust cloud

Numb E p m t	LOCATION AND CHARACTER OF BREEDING AREA	B nd P G een	P d P Paris G n Acr	T m Applic t	C D l t	P G e P t M x t by W ght	A pp P n T t	Check Bef Appl t: N mb D p	Check Bef Appl t: T t l L	Check Aft Appl t: N K	Check Aft Appl t: N mbe D p	Check Aft Appl t: L L T k n	P t M rtal ty +: I P	P t M rtal ty +: I B ed A
1	Lak Mart n, Bro h Weeds	A	1	9 A M	S p to	1		60		6	60	2		97
2	L k M rt B ush Weeds	B	1	10 A M	S p to	1 ×		60	30	6	60	1		9
3	L k Mart Bru h W ed	A	1	10 A M	S p to	1	no	50	100	5	50	47		53
4	D tch de d eg ta n	B	1	3 P M	S p to	1		10	44	20	10	8		56
5	D tch dead v g tat	A	1	3 P M	S p to	1		10	59	4	10	7	—	88
6	D tch dead eg tati	B	1	4 P M	Kaol Dust	1 ×		10	88	24	10	17		82
7	D tch dead g t ti	B	1	4 P M	Kaol Du t	1	yes	10	2	24	10	10	100	55
8	D tch d d eg tati	A	1	5 P M	Kaol D t	1		10	50	4	10	9		8
9	D tch d d get t	A	1	3 P M	S p t	5		10	43	24	10	13	95	0
10	D tch d d tat	A	1	2 P M	S p t	5	yes	30	206	4	30	68	65	I
11	Dit h de d g tat	A	2	3 P M.	S p to	5	yes	30	1 6	4	30	112	96	36
[illegible]	D tch d ad g tat	C	1	3 P M	S p t	5	y	30	245	4	30	221	100	10
13	D t h de d g t t	C	1	7 A M.	So p to	5		30	444	24	30	6		40
[illegible]	D tch d d eg tat	[illegible]	1	8 A M	So p to	5	yes	[illegible]	521	24	30	206	[illegible]00	86
15	D tch d d egetat	C	1	9 A M	S p t ne	5		30	6	4	30	3 9		48
[illegible]	D tch dead eg t t	A	2	12 A M	S p t	60		20	268	6	30	1 5		53
17	Small P d, l g s ass	[illegible]	1	4 P M	Hyd. L m	15	yes	20	104	6	30	0	100	100
18	Small P d weeds Alg	C	1	4 P M	So p to	15	yes	20	93	6	30	2	100	98
[illegible]	Sm ll P d d d l	C	1	10 A M	Hyd. L m	[illegible]	yes	10	62	6	10	1	100	98
20	Sm ll P d heavy A g	C	1	10 A M	S p t	5	yes	10	8	6	10	0	100	100
21	Small P d h vy Al ae	A	1	11 A M	H d. Lim	15	yes	2	8	10	0	0	100	100
22	Sm ll P d, h y Algae	A	1	11 A M	S p t	5	es	[illegible]	69	6	10	2	100	97

Pa i G n graded t pa 330 n h nd B eta ned on 00 mesh n
+ Sm ll f t t g la ae t ou ted.
× C ppe A nate

SUMMARY AND CONCLUSIONS

(1) With few exceptions petroleum products have had successful application for control of anopheline larvae on impounded waters in Alabama which were impounded according to the State regulation

(2) The efficiency of oiling equipment has been rapidly developed since the first major oiling operations were undertaken on Lake Mitchell in 1923

(3) There developed certain areas in Lake Martin in 1927 where oil failed to control breeding

(4) Following the agreement to use paris green in 1928 decision was made to apply the dust through use of a power duster mounted on a boat The machine was to be supplemented by knapsack hand dusters Powdered soapstone was selected as a diluent after considering hydrated lime kaolin and road dust

(5) After preliminary trial a 5 per cent mixture of paris green was found more suitable for general application than a 1 per cent mixture

(6) Inspection following the applications of paris green showed that larvae mortality was not uniform in all places

(7) A series of tests and observations was made in an attempt to ascertain the reason for non uniform results with the following findings

(a) The paris green being used on Lake Martin was satisfactory as to chemical content of arsenious oxide

(b) The fineness of the paris green appeared satisfactory It was found however that paris green retained on a 200 mesh sieve was entirely too coarse for larvicidal work From our observations it is thought that a more limiting specification on paris green as to coarseness would be that it pass almost entirely through a 300 mesh sieve No information was obtained

which might indicate a limiting size as to fineness

(c) Of the diluents used in the tests (kaolin soapstone hydrated lime) no one was observed to be distinctly superior to the others considering larvae mortality alone

(d) Due to varying influences as wave action, wind currents and water tension at the surface, paris green is not equally effective on all breeding area

(e) As the aquatic growth flotage and scum increase in density in an area the possible effective use of paris green also increases with a decrease in the possible effectiveness of use of petroleum as a larvicide

(f) The effective and economic use of paris green as an anopheline larvicide on large reservoirs in Alabama impounded strictly under the regulations is limited to those areas which cannot be successfully handled with oil

As has been pointed out heretofore by other investigators it is being suggested to future users of paris green that each lot received be analyzed to ascertain that it contains the minimum of 50 per cent arsenious oxide In addition it should be given the pan tests on larvae for toxicity Complete mortality should result in about two hours However one of the most important tests to be made in obtaining a true index of what may be expected is to apply the paris green to an experimental area entirely similar to the larger area to be controlled in the same percentages the same amount per acre and using the same diluent

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6 LePrince J A Memorandum on the Airplane Distribution of Paris Green in the Control of Anopheles Production in Uncleared Pond Near Bamberg South Carolina

7 Niagara Spray Company Middleport N Y

8 Fl sco Manufacturing Company Jacksonville Florida

9 Southern States Chemical Company Birmingham Alabama

10 Product of Ansbacher Insecticide Company 5 7 Fifth Avenue New York N Y

11 Bingham J B Personal communication Sherwin William Co

12 Barber M A and Hayne T B Arsenic as a Larvicide for Anopheline Larvae

13 Valuable assistance was rendered in making the field tests by Mr T H Milford Assistant Sanitary Engineer Alabama State Board of Health

14 Willson Dustite Muzzle

MALARIA CONTROL ACTIVITIES IN ARKANSAS, 1927 1928*

By M Z Bair
Little Rock, Ark

Compared with the years 1926 and 1927, Arkansas experienced an increase in the amount of malaria during the past year This statement is based on a 10 per cent increase in the number of deaths reported and on the advice of physicians generally

Following the floods of 1927, with the assistance of the United States Public Health Service and the American Red Cross, intensive control measures were conducted in the rural areas affected As a result of this work, there was no increase in reported malaria It is very probable that failure to continue this work as intensively as in 1927 resulted in the increase during the past year

The Field Director of Malaria Control has supervised activities in thirty one communities by making regular visits throughout the season Advice and assistance was also given to the officials of nine other communities The Director also assisted the full time county health units in inaugurating rural work, and it is hoped that these units will be able to devote more time to malaria as it is realized that in Arkansas malaria is largely a rural problem

Arkansas has been greatly aided by the work being done by the railroads The St Louis Southwestern (Cotton Belt), Missouri Pacific and Chicago Rock Island and Pacific systems have expanded their activities in the State, and through mosquito prevention and quinin prophylaxis are greatly reducing malaria among employes and the citizens of towns on their lines The educational and publicity measures employed by the railroads are most effective in helping to bring about a widespread desire for the elimination of this disease Their activities are a real contribution to public welfare and exemplify a fine spirit of public service

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*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Second Annual Meeting Asheville North Carolina November 12 15 1928

MALARIA IN FLORIDA 1928*

By E L Filby
Jacksonville Fla

This year witnessed a period of heavy rains and high water throughout the State for almost the entire Anopheles season As a result we have a marked increase in malaria in our malaria section, which lies west of the Suwannee River and east of Holmes Creek a branch of the Choctawhatchee River Failure of physicians to report these cases has had a pernicious effect as control measures could not be instituted in time Industry has been brought face to face once more with the fact that malaria is not an aid to good business The start of an entomological study of the fresh water mosquitoes of Florida has been made by the United States Bureau of Agriculture Bureau of Entomology in *cooperation with the State Board of Health* The control of brackish water mosquitoes has been urged and a general bill will be introduced at the 1929 Legislature allowing boards of county commissioners to levy a millage for mosquito control work Interest in this work has been kept alive by the usual methods There has been practically no interest displayed by the communities in our malaria section Three coastal counties are doing salt marsh work at this time

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MALARIA CONTROL IN GEORGIA FOR THE YEAR 1928*

By T F Abercrombie M D †
Atlanta Ga

The work of malaria control in Georgia for the year *1928 comprised chiefly the making of* malaria surveys together with recommendations for cities towns and communities and of assistance rendered county health officers investigations of epidemics and institution of control measures

Control of hydro electric impounded areas required practically the whole time of one engineer There are now in the State of Georgia over 100 000 acres of impounded areas for hydro electric purposes which acreage is divided between about thirty six hydro electric plants *Impounding of more acreage is contemplated* during the year 1929 All of the impounded areas are either cleared or are in the process of clearing At least three of these areas are under continuous oil control The cooperation now being received by the State Board of Health from the various power companies is very gratifying and it may be stated that the time has arrived when power companies value the control of impounded areas not only as an important health measure but as a legal protection to the power companies

Sectional meetings have been held with county health officers in an effort further to promote rural malaria control in the State Wholesale quinin distribution drainage and screening is anticipated for the coming year in order that the rural people may be better protected against malaria Malaria education is also being intro*duced into the schools through general* public health education

The year 1928 has been an unusual year in amount of rainfall and the result has been an increase in malaria infection Due to this fact we anticipate also a high malaria rate for the year 1929 and every precaution is now being taken to keep the rate down to a minimum

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MALARIA WORK IN KENTUCKY 1928*

By A T McCormack M D
Louisville Ky

While malaria is one of our minor problems it has been increasing the last two years since the flood In the county in which we had the most malaria we happened to have $500 00

We are going to have an enormous increase *in malaria unless* some steps not yet formulated are taken A large number of laborers are going to be deposited in the malaria section a larger number than have ever been similarly imported The danger to the public health from this population s being suddenly dropped into this section is going to be tremendous. The roads will have to be rebuilt and re located An enormous expenditure will be called for and the counties will not be able to handle it alone It seems very important that our Congressmen from the South understand the tremendous prob

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†State Health Commissioner

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lem that will confront us as these hundreds of thousands of laborers are transported suddenly into the malarial sections

MALARIA WORK IN LOUISIANA 1928*

By Oscar Dowling M D,
New Orleans La

The campaign has been carried on in Louisiana on the same basis as prior to this and I am sorry to report have had a slight increase in the number of cases of malaria since the flood We endeavored to supply quinin for those who wanted it and the largest amount of quinin went where there had been no official reports of malaria

In Shreveport we had last year a demonstration of screen making at the Fair and we screened a large number of homes on the farms at a nominal price One man had four houses on his place and I think there were sixteen doors and fifty windows to those four houses and they were screened for him at a cost of less than $20 00 Some of the farmers of the State have screened the majority of the homes and the prospects are that practically all of the homes will be screened

We have had a few deaths from malaria but we have nothing to show that there has been any increase One sanitary engineer devotes his entire time to this work and he helps them to get it started and comes back later Of the 64 parishes 31 have full time men

MALARIA CONTROL OPERATIONS IN THE STATE OF MISSISSIPPI DURING 1928*

By Felix J Underwood M D
Jackson Miss

The major malaria problem in the State of Mississippi is confined to the fourteen Delta counties in which reside approximately 25 per cent of the State's population and among whom about 50 per cent of the State's reported malaria cases occur each year

In this territory there are eleven full time health units, and in the State there are twenty six such units

The policy of the State Board of Health is to include malaria control operations in the regular county program of full time units in those counties having malaria problems

Aid is rendered from the central organization through the Division of Malaria Control to all sections of the State

In Humphreys and Leflore Counties, as part of the program of the full time health departments, malaria control work was given serious consideration and a great deal of work done during the year

Coahoma, Bolivar and Sunflower Counties were grouped into a general malaria control unit aid from the central office being rendered in working out practical programs for the three full time health departments concerned

Control operations began in 1922, were continued by the full time health unit in Yazoo County

In Hinds County, and particularly the City of Jackson malaria control work was firmly established during 1928 as part of the county health department s program

While all full time health units have done some malaria control work, the above lists the outstanding projects

Thirteen municipalities, with an aggregate population of 169 000, carried on general mosquito control programs during the year, and insofar as anopheline mosquitoes were controlled the transmission of malarial fever was affected

The desire of the urban population is for general mosquito control, and many towns throughout the State annually conduct such programs of their own initiative

Plantation owners having had various malaria control measures explained as being suitable for practical use on their plantations, have taken up the work and in a number of such cases minor drainage projects have been mapped out for them to be handled after the cotton crop is disposed of Such work makes available additional acreage for cultivation and reduces mate

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tially the local production of Anopheles mosquitoes

Of outstanding importance are malaria control operations which have just been started on a plantation group of 35 000 acres

Some 24 000 acres of this plantation group were in cultivation this year supporting 761 houses occupied by 2 623 colored persons The immediate plan of the owners is to increase the number of families to 1 000 which will give a population of 4 000 to 4 500

The malaria problem has been gauged by collecting histories by a house to house canvass on the fifteen units into which the plantation is divided There were obtained 1 081 colored histories for 1928 or a rate of 41 2 per cent The data relating to the white population occupying 47 houses located largely in the town have not at this time been compiled

Of 1 598 blood films collected from colored tenants the examining to date of 769 gives a positive blood rate of 16 6 per cent

Each unit of work was separately conducted and each unit of area was separately dealt with histories for 1927 and 1928 age sex color length of residence type of dwelling anopheline density anopheline production methods of practical application of control measures a 61 per cent blood index were included for the malaria study

General information pertaining to excreta disposal water supply number of cows and milk consumption garden and kind of vegetables raised tuberculosis suspects and pellagra cases noted in connection with the malaria work was recorded at the cost of little or no additional time

All persons whose blood was found to contain malarial parasites were immediately placed under treatment of the plantation physician

A program of control embracing all of the known effective and practical measures to be applied where they fit has been mapped out

A sanitation program including the installation of sanitary excreta disposal units was placed in operation immediately following the survey

This survey took about twenty-one working days and was worked out and supervised by the Division of Malaria Control of the central organization

Similar sectional surveys are being extended into other counties and in these areas drainage of both a large and small nature is being gotten under way

Cooperation with dynamite agencies plantation owners drainage commissioners and city officials has opened the way for some extensive drainage this winter when vegetation is less dense the soil more suitable, and labor more plentiful

While the general trend of malarial fever in Mississippi is downward this year as well as 1927 has shown an increase over the preceding year

As part of the activities of the year cooperation was rendered in connection with working out of a program for the control of the salt marsh mosquitoes in the three Mississippi Gulf Coast counties This cooperation included aid in preparing and securing the passage of a bill by the 1928 Legislature entitled An Act Enabling the Establishment of County Mosquito Control Commissions and to Define Their Powers and Duties and for Other Purposes (H B 1157)

This Act was passed and on April 23 1928 was signed by the Governor

The original bill extended its provisions to all eighty two counties but an amendment was added limiting its effectiveness only to those counties bordering on tide water and on the Mississippi River

No distinction is made regarding the class of mosquitoes so it may also as was the aim serve by enabling certain counties to assess themselves for the control of malaria transmitting mosquitoes

Harrison County appropriated $20 000 under this Act Hancock County appointed commissioners and both Hancock and Jackson Counties plan to make substantial appropriations in 1929 to insure a general and cooperative control program in the three coastal counties in Mississippi

It is hoped that Louisiana and Alabama will enact similar legislation to enable Mississippi to extend cooperation to its neighboring states

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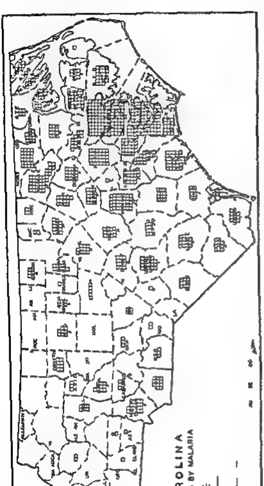
the disease is prevalent enough to justify the effort and expenditure of money. While the primary object of the division created is necessarily the mapping out of the malaria problem in all the counties within the malaria zone and instructing employes of local county health units in measures for the control of the disease there is a secondary object of even greater importance which is the stimulation of permanent interest and activity in public health work in general and the local administration of methods whereby disease prevention can be carried on economically and on a large scale by free and generous support of full time local health departments.



MAP OF NORTH CAROLINA
GIVING LOCATIONS OF DEATHS BY MALARIA

In addition to rendering aid and advice to county health departments in the control of rural malaria the Division has been engaged in studying (a) what if any influence the impounding of waters may have upon the incidence of malaria (b) malaria and mosquito surveys in urban areas and (c) salt marsh mosquito problems.

STUDIES ON IMPOUNDED WATERS

The studies on impounded waters were conducted with a dual purpose: first to safeguard communities from the hazards and accidents to health that have proved to be the companions of oversight imprecaution or lack of knowledge in the construction of ponds; second to set forth facts and knowledge surrounding the impounding of water in order that power developers and other interests might utilize them in clearing the flanks of a basic industry and lead other industries to whom they furnished power to recognize and aid public health projects.

To serve these purposes two courses were followed. Prior to impounding sites were surveyed over extended periods of time to ascertain and record something of the prevalence of malaria and malaria carrying mosquitoes (*Anopheles quadrimaculatus*). Record of past conditions tendencies and possibilities were thus compiled and rendered available to all concerned.

Following impounding periodic inspections of ponds were made. Written and photographic reports of findings were rendered thus putting in the hands of those concerned definite data on developments and tendencies. In this manner it was hoped to avoid the pitfalls of oversight and to aid in reducing the friction of change and readjustment.

SURVEYS OF URBAN AREAS

Surveys of urban areas have been conducted with two aims (a) to control disease and (b) to eliminate pests. In disease transmission *Anopheles quadrimaculatus* and malaria were the chief concerns. However possibilities are not limited here for *Aedes aegypti* or Stegomyia,

MALARIA WORK IN MISSOURI 1928*

By W S PETTY M D
Caruthersville Mo

I happened to be in the southeastern part of Missouri where malaria is a problem. Particularly *in seven counties it is a serious problem*

We have been doing some screening and Mr LePrince and Mr Johnson have been helping us considerably in that area

Last year at our State Conference the health officers the seven full time men took up most of the time with malaria The other men rather resented the fact but just this year near Kansas City and the central part of the State there are some impounded projects some power sites and some pleasure resorts and I was informed the other day they were beginning to receive quite a number of blood smears from that section

Doctor Stewart State Health Commissioner is very keenly interested in malaria control measures This year or the next Legislature which convenes in January they hope to have some legislation regarding the impounding of waters in the State of Missouri

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*MALARIA ACTIVITIES IN NORTH CAROLINA**

By CHAS O H LAUGHINGHOUSE M D
Raleigh N C

An ever increasing demand on the State Board of Health by county officials property owners and others interested in public health work for a more comprehensive plan for dealing with the malaria problem of the State led the members of the Board during 1921 to consider a means for accomplishing rural control with the idea in mind that any findings obtained during the initial work might be made a part of the routine of the health department of the State

As the mortality records furnished the only available data relating to the prevalence of malaria, and as this was found to be inadequate as a basis for formulating a control program it was decided to undertake intensive surveys in some of our eastern counties in order to determine first the incidence of the disease and the extent to which it is a menace to the health and economic efficiency of the people second, the possibility of controlling the disease at a cost within the economic reach of the average county

A study of the data collected during these surveys and of the morbidity statistics of the State indicates that malaria is of serious public health importance only in that group of counties about two in width bordering along the Atlantic Coast with a higher incidence in those counties affected by tide water through their small streams leading to Pamlico Sound and the Atlantic Ocean (see *Map*)

A more careful study of the available records for that group of counties bordering the coast would lead one to believe that the mortality from malaria although subject to annual fluctuation is decidedly on the decline This decline in the death rate is perhaps due largely to the less severe types of the disease rather than to a true decline in the incidence All along the eastern coast of the State, where malaria is to be found in abundance and where it is a menace to the health of the people one will find an even climate not too cold for more than four months of the year, to prevent sporadic mosquito flights and a water table nowhere lower than a few feet below the surface The elevation of each county is only a few feet above sea level and a majority of counties feel regularly the effects of tidal waters The soils range from the light deep sandy soils of the interior to the deep black pasty swamp lands near the coast The low swampy condition of almost the entire eastern section of the State and tidal waters covering the low lands at regular intervals offers excellent opportunities for the propagation of malaria carrying mosquitoes and *it is in these regions that* the State Board of Health is attempting to concentrate its efforts in the control of the disease

Since the inception of the work in 1921 which was in cooperation with the International Health Board of the Rockefeller Foundation *the organization* of the State Board of Health has embraced a Division of Malaria and Mosquito Control through which aid both advisory and supervisory is rendered throughout the State on *problems pertaining to the investigation* and control of malaria and mosquitoes The division thus created seeks to organize local county health departments whose duty it is to carry on investigations and control measures wherever

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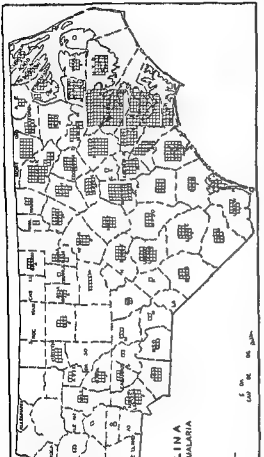
*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Second Annual Meeting Asheville North Carolina November 1 1 1928

the disease is prevalent enough to justify the effort and expenditure of money While the primary object of the division created is necessarily the mapping out of the malaria problem in all the counties within the malaria zone and instructing employes of local county health units in measures for the control of the disease, there is a secondary object of even greater importance, which is the stimulation of permanent interest and activity in public health work in general and the local administration of methods whereby disease prevention can be carried on economically and on a large scale by free and generous support of full time local health departments



In addition to rendering aid and advice to county health departments in the control of rural malaria the Division has been engaged in studying (a) what if any influence the impounding of waters may have upon the incidence of malaria (b) malaria and mosquito surveys in urban areas and (c) salt marsh mosquito problems

STUDIES ON IMPOUNDED WATERS

The studies on impounded waters were conducted with a dual purpose first to safeguard communities from the hazards and accidents to health that have proved to be the companions of oversight imprecaution or lack of knowledge in the construction of ponds second to set forth facts and knowledge surrounding the impounding of water in order that power developers and other interests might utilize them in clearing the flanks of a basic industry and lead other industries to whom they furnished power to recognize and aid public health projects

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SALT MARSH SURVEYS

Salt marsh mosquitoes *Aedes sollicitans* and *Aedes taeniorhynchus* have attracted an increasing amount of attention probably due in some measure to increasingly favorable conditions for their production but primarily due to their standing in the way of agricultural and industrial progress. As an answer to the demand for attention to this problem the State cooperated with the United States Public Health Service in conducting salt marsh surveys.

MALARIA REPORT FOR SOUTH CAROLINA, 1928*

By R. G. Hamilton, M.D.
Columbia, S. C.

During the first part of the year the malaria case rate ran about on a par with former years. During the latter part of the summer three severe storms each caused an overflow along the river valleys in the lower part of South Carolina which produced enormous quantities of quads breeding in cotton patches and corn fields causing an epidemic in Clarendon, Marion and Colleton Counties.

Immediate steps were taken for the control of these epidemics and good results were obtained by the use of quinin. This quinin was provided by the American Red Cross. Marion County provided $2,000 for the purchase of quinin and other necessary drugs for those affected with malaria in the lower part of the County.

The Malarial Department has visited practically all of the towns and cities in the State getting cooperation from the city and county health officers in the control of breeding in their respective towns.

The impounded waters of the State have been inspected at various times during the year and practically no breeding was occurring on any of these projects. A continuous study was made during the summer of the Lake Murray area. Control measures have consisted in the screening of houses, oiling, dusting and ditching.

The State Highway Department has cooperated in a wonderful manner by opening drainage ditches on their rights of way, and where this was impracticable installing oil drips or using oil sprays.

In the town of Bamberg the drainage system was practically wrecked by the falling of trees into the ditches and the caving of the banks.

The funds for the malaria work in South Carolina are contributed by the International Health Board and the State. Doctor Ferrell kindly lent the State Dr. L. T. Coggeshall for work on the Saluda Dam project.

During the year Mr. LePrince, of the United States Public Health Service has continued his series of lectures to the engineering students of the three State colleges. These men are future engineers for the State Highway Department and other projects where knowledge of malaria prevention will be of value. Mr. Legare, the Chief Engineer of the State Board of Health, has cooperated in every way possible.

During the year Dr. L. L. Williams of the United States Public Health Service, has visited us several times rendering valuable assistance in suggesting certain control measures in various sections of the State.

PROGRESS REPORT OF MALARIA CONTROL IN TENNESSEE IN 1928*

By E. L. Bishop, M.D.,
Nashville, Tenn.

Both extensive and intensive study and definition of our malaria problem in the western section of Tennessee are being carried out from Lake County as a field base. With one exception every county in the tier bordering the Mississippi River now has a full time county health department and both study and control activities are, therefore, more surely productive of results.

Twenty two cities and towns did mosquito control work this year. They are Memphis, Covington, Ripley, Halls, Dyersburg, Union City, Franklin, Tiptonville, Ridgely, Martin,

*Report to National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty Second Annual Meeting, Asheville, North Carolina, November 1 15, 19 8.

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Trenton, Humboldt Milan Cookeville Brownsville, Dresden Jackson Cowan Murfreesboro Chattanooga and Greenfield

Memphis was the largest city doing anti mosquito work Thousands of gallons of waste oil from filling stations were used and bayous and ditches throughout the city were trimmed free of grass and weeds and oiled regularly Memphis was without the service of a full time sanitary engineer this year and a sanitary engineer from the State Health Department was detailed to give consultant service throughout the season

Activities in other cities and towns consisted mainly of oiling clearing and ditching of streams Preliminary surveys estimates of cost where needed and inspection trips during the mosquito breeding season were included in the services of the State Department of Health

Tennessee had two impounded water problems during the year The Tennessee Electric Power Company did paris green dusting over one of its large backwaters that could not be otherwise satisfactorily controlled at this time The City of Cookeville carried on control work at the Falling Water River reservoir A partial break in this dam which lowered the water level about six feet materially improved the shore line for mosquito control as it left no vegetation whatever in the water The dam is being rebuilt and raised In Lauderdale County fifty four homes on a single large plantation were screened for study and demonstration purposes Paris green dusting was also done on this plantation to control *quadrimaculatus* breeding over one small and one very large marshy area near the homes

In Lake County a county wide screening program was inaugurated early in the year Lake County has the highest malaria rate of any county in the State It borders the Mississippi River on the west and Reelfoot Lake on the east and is traversed by several bayous Mosquito proofing is being done this winter

A total of 2 152 doors were made this year for 880 homes in Lake County Last year 165 homes were screened making a total of 1 405 homes in Lake County screened to date or 59 7 per cent This does not include a large number of homes that were screened as a result of the campaign by the owners themselves

MALARIA CONTROL IN VIRGINIA*

By H G Grant M D
Richmond Va

In thirty one unorganized counties educational work has been carried out through the schools pamphlets giving the theory of malaria transmission and dealing with practical methods of control have been distributed to the homes In our organized counties education and control has been carried out where deemed necessary

In the ten organized counties in Tidewater Virginia with a total population of roughly one quarter of a million there were four deaths from malaria reported in 1927 and up until the time of writing no deaths in 1928 The number of cases reported from this group of counties has been exceptionally low in 1927 only 188 cases were reported and up until the time of writing in 1928 126 cases It is probably true that the number of cases reported is far too low and if anything the number of deaths is too high

In Northampton County in Cumberland County and in Southampton County control has been effected by the use of paris green dust In Nansemond County and in Isle of Wight County control has been carried out by fluctuation of water level by drainage and by screening Drainage and regular oiling has been carried out in Greensville County Pest control has been effected by drainage and the use of oil at Virginia Beach in Princess Anne County Tappahannock Suffolk and in Orange County

A check up on our reporting system by the thick film method of blood examination is at present being conducted in cooperation with the United States Public Health Service School children are being examined in parts of the State where we know malaria has previously been prevalent It is expected that we shall make about 10 000 examinations and in this way get an accurate estimate of the present status of malaria

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SYMPOSIUM ON MALARIA

Papers and Reports Presented before the National Malaria Committee and the American Society of Tropical Medicine, Both Meeting Conjointly with the Southern Medical Association, and before the Section on Public Health of the Southern Medical Association, Twenty Third Annual Meeting, Miami, Florida, November 19 22, 1929

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Pages 41 409

RECENT DEVELOPMENTS IN THE CONTROL OF MALARIA*

By W E DEEKS M D †
New York N Y

The importance of preventing anopheline mosquito-breeding in order to control malaria has long been appreciated and it was practically demonstrated in Panama during and subsequent to the period of the construction of the Canal At that time however the importance and practicability of treating cases of malaria in the homes and labor camps were not recognized Many of the laborers remained for days in their homes or camps suffering from fever until they developed grave conditions which brought them to the attention of the sanitary officers who sent them to the hospitals In the medical wards of Ancon Ho pital it was not unusual to admit in a single day one hundred or more cases of acute malaria from the laboring population alone During the rainy season the available beds were constantly filled with patients and frequently many had to be placed on the floors which were occasionally so crowded that the physicians had to step over them in making the rounds

In the early days of the construction of the Canal malaria cases remained in the hospital under treatment for three or four days only or until the fever and acute symptoms subsided when they were discharged and returned to duty Many of them relapsed even before they reached camp and were ho pitalized again for further treatment

The writer was impressed with the poor physical condition of many of the patients who were anemic from chronic malaria malnutrition syphilis or hookworm infestation and therefore offered little resistance to infections of different kinds It was consequently decided to detain them in the hospital under treatment and on a nutritious diet until they showed at least five days of continuous normal temperature and their general physical condition was improved In addition to the administration of quinine their detention enabled us to give one or two hookworm treatments before they were discharged and also to initiate treatment for complicating constitutional conditions At that time the routine treatment for malaria consisted of 30 grains of quinine daily usually in three doses Calomel was administered on admission and a dose of magnesium sulphate was given a few hours later The first hookworm treatment was given when the fever had subsided and in severe cases of infestation the treatment was repeated within a few days Generous diets were provided as soon as their appetites returned It was soon apparent that these measures improved the physical condition of the patients and thereby prevented relap es and the procedure was put in effect as a routine method in all the hospitals on the Zone

It did not occur to the clinicians at that time to re examine the blood of patients for malaria parasites when they were discharged Had this been done we hould probably have found that many of them were reservoirs of prolific gametocyte infection and returned to the camps under ideal conditions to infect mosquitoes and pread the disease

During the summer of 1926 Dr H C Clark in making blood urveys in the plantations of the United Fruit Company observed in the blood of patients convalescent from acute attacks that though the schizonts had disappeared from the peripheral blood in some cases the gametocytes were far more numerous than before treatment was given and that the incidence of rich gametocyte infection was greater in the hospital treated cases than in those from the camps to whom little or no treatment had been given Naturally most of the ca es sent to the hospital were suffering from acute attacks These observations have been confirmed by other members of our staff In order to account for this condition it must be realized that the fever incidental to malaria infection is due to the toxin liberated at the time of sporulation and the greater the number of parasites sporulating at

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*Pr id t s Add e Am ri n S ty f T pical Medicin (me ti g jointly with S th n M di al As lati n) Tw ty Thi d A al M ti g Miami Flo id N mb 19 19 3

†G l M M di al Dep tment U it d Fru t C

interfere with their infectiveness to mosquitoes This statement applies particularly to the estivo autumnal parasites We have not yet had sufficient opportunity to form a definite opinion as to its effects on these stages of the parasites in cases of the benign forms of malaria When the schizonts are destroyed and their proliferation prevented with quinine no new gametocytes can be produced as their source of production no longer exists That quinine does not devitalize the gametocytes to such a degree as to prevent mosquito infection has been repeatedly demonstrated in our plantation work Mosquitoes fed on patients with rich crescent infection during and following the administration of quinine generally develop a large number of oocysts which mature and render the mosquitoes infective

The effects of plasmochin on the crescents however, is a different story, as it does what quinine and its salts fail to do It devitalizes the gametocytes so that patients who have received a sufficient dosage of this drug are not infective to mosquitoes This property which plasmochin possesses makes the discovery of the drug one of the greatest advances in recent years in malaria control

When plasmochin was first used in our plantations in 1926 generally in combination with quinine it was considered necessary to give it in doses of from six to eight centigrams daily for five or six days Treatment was suspended for a few days and the course was then repeated In this dosage toxic symptoms were frequently observed, and an occasional death occurred At that time we expressed the opinion that its usefulness was limited as it was believed that it could be safely administered only to hospital patients under direct medical supervision However, after considerable experimentation in our hospitals, it was determined that a much smaller dosage would accomplish the same results and would not produce toxicity Dr O T Brosius initiated this line of research and the benefits derived from his investigations are obvious as he was able to demonstrate conclusively that it could be used safely and efficiently in field and dispensary work This materially extended the scope of usefulness of the drug

The next advance in our knowledge concerning the utilization of plasmochin was the result of the research work done by Dr M A Barber and Mr W H W Komp of the United States Public Health Service in our Panama Division during January and February 1928 They demonstrated that mosquitoes fed on quinine treated cases which were carrying numerous gametocytes invariably developed large numbers of oocysts in their stomachs but that no oocysts could be found in mosquitoes fed on the same patients after they had taken one compound tablet containing 1 centigram of plasmochin and 0 125 grams of quinine, despite the fact that they were still carrying an equally large number of gametocytes In one case one half a tablet proved efficacious The work was repeated by them in the early months of 1929 in a few suitable cases (that is with rich crescent infections) and the results were equally satisfactory This work was of such importance and significance that Dr Eugene R Whitmore of Georgetown University, Washington, D C, proceeded to Puerto Castilla Honduras with the object of undertaking experimental work along the same lines as those followed by Barber and Komp He found that the administration of 1 centigram of plasmochin to Honduranian laborers did not always prevent oocysts from developing in the stomachs of the mosquitoes but that they were few in number when compared to those which developed in mosquitoes fed on patients who had not been given plasmochin Furthermore a single dose of 2 centigrams of plasmochin proved successful in all the cases treated and in no instance did the mosquitoes fed on patients for seven successive days thereafter develop an oocyst These results appear conclusive and if further confirmed plasmochin will become an almost indispensable agent in effective malaria control

In the plantations of the United Fruit Company which for the most part are located in highly malarial districts and inhabited by people who will not take advantage of the protection afforded by screened quarters even when they are provided we began a malaria-control campaign towards the end of 1926 A single thick film survey showed an average infection rate of more than 40 per cent in most of the divisions which meant that probably 80 per cent of the laboring population were carrying parasites

The malaria control program included

First short radius mosquito breeding control by the recognized sanitary measures drainage filling or larvicidal treatment of all water surfaces within one hundred to three hundred yards of all dwellings

Second repeated thick film blood surveys in order to determine the incidence of infection and to obtain progress reports.

so severe that vomiting and even hematemesis are produced

(3) Those who are nauseated or vomiting from the true gastro intestinal form of malaria In the American tropics this group is of the greatest *importance and the most frequent in incidence*

(4) Unconscious patients usually suffering from the algid and cerebral types of malaria

(5) Individuals who are too ignorant indolent or prejudiced to persist long enough in the oral administration of quinine

Intravenous and Intramuscular Injection of Quinine —The dangers and disadvantages of these routes of administration are too well known to warrant discussion Maxcy[1] in a report collaborating with the special committee of the Council of Pharmacy and Chemistry of the American Medical Association has supported the view that the therapeutic action of quinine in malaria results not from direct contact of the drug with malaria plasmodia but rather through the medium of a metabolite formed by quinine decomposition or alteration in the liver and capillaries This committee confines its indications for the use of quinine intravenously to gastro-intestinal forms of malaria and to cerebral types The necrotizing action of quinine alkaloids and salts upon tissue has been fully discussed by Dudgeon[3] and Fletcher[4] Abscess formation necrosis severe secondary hemorrhage fatal septicemia and sciatic nerve paralysis have been observed by the writer to follow intramuscular gluteal injection of quinine and should relegate this mode of application to the most severe infections vomiting cases and unconscious and convulsive forms Unfortunately a large proportion of malaria cases applying for treatment in tropical America are of such severity that parenteral administration of quinine must be carried out at least as an initial measure

Quinine by Rectum —A test of the rectal administration of quinine was decided upon in the hope of finding a therapeutic method which would make unnecessary intravenous or intramuscular quinine injection in vomiting patients and cerebral types Caution in selecting cases has not yet permitted a trial of the method in these case groups *The excellent results obtained* in treating a small series (eleven) of mild and moderately severe cases of malaria by the rectal instillation of quinine would seem to justify extending the trial of the method to more unfavorable cases

Past Experience —In the past many attempts have been made to effect routine rectal quinine administration, but the method has found little favor because of the resulting burning irritation tenesmus and diarrhea and uncertainty as to the quantity of the drug absorbed

Wilcox[5] quoted by Ross[6] has estimated (clinically) that quinine administered by rectum is only half as effective as when given by mouth and that both of these methods are inferior in point of effectiveness to the intramuscular and intravenous routes Suzuki[7] on the other hand reported that the minimal lethal dose of quinine administered by rectum to rabbits was 0 33 gram per kilogram while by mouth it was 0 66 gram per kilogram He habitually uses the rectal route in clinical practice administering daily 100 c c of a 0 5 per cent solution of quinine hydrochloride in water The results reported by Suzuki from this small dose (0 5 gram) given daily by rectum made a favorable comparison with cases treated by mouth Generally speaking they caused no uncomfortable local disturbances

It is clear that so small a daily dosage would not be effective in treating a majority of the malaria cases seen in native laborers of the Caribbean zone Furthermore larger quantities of quinine in watery solution have proven too irritating to the rectal mucosa The technic devised by the writer and described below has permitted the exhibition of quinine by rectum in large dosage without discomfort to the patient or inability to retain the medicament

Effectiveness of Method —Infection by all varieties of malarial organisms as well as mixed infections have been successfully dealt with in this manner No case has failed to respond to treatment and in none has treatment been modified or supplemented by oral or parenteral administration of quinine (excepting in those cases receiving an initial routine dose of quinine by mouth upon admission and before the establishment of definite diagnosis) Furthermore clinical cure as well as elimination of parasites from the peripheral blood has been accomplished as rapidly and as effectively as by oral administration

CASE RECORDS

Ring forms are denoted O gametes C marked infection one plus heavy infection two plus severe infection three plus dangerous four plus The designations are those of Mr L R Matthews Laboratory Technician Quirigua Hospital who made all blood examinations and reports as a part of the routine laboratory work

HOSPITAL ADMISSION RATE FOR MALARIA (PRIMARY DIAGNOSES ONLY)*
Per Thousand Employees Per Annum

Year	Colombia Division	Costa Rica Division	Guatemala Division	Panama Division	Tela Railroad	Truxillo Railroad	Banes Division	Preston Division	Total
1925	90 78	161 97	287 72	260 93	172 00	261 13	630 92	282 01	254.3
1926	69 76	254 97	286 81	160 50	133 22	188 [illegible]4	535.32	169 49	222.85
1927	36 63	249 99	205 06	107 73	179 23	195 51	154 50	124 21	150 97
1928	64 40	162 49	146 19	124 28	112 80	[illegible]2 63	62 5	44 45	106.59
1929	96 76	100 62	100 64	75 55	116 09	166 45	36 71	19 73	84.69

*The first nine months of each year January to September inclusive have been used [illegible] the figures for the last three months of 1929 were not yet available when this table was compiled But the figures given show the rate per thousand per annum for the periods covered

Third frequent visits (daily, wherever possible) to the homes and camps with the object of discovering the sick and treating them immediately Patients giving a history of recurring chills and fever were given a sufficient quantity of quinine and plasmochin to provide a complete course of treatment and were definitely instructed as to how the drugs should be taken It is believed that if patients are treated in their homes and camps in the early stage of a relapse or a primary infection, few gametocytes develop whereas if they are allowed to remain untreated in camp for several days they become reservoirs of rich gametocyte infection The persons who are seriously ill are referred to the dispensaries or hospitals

Fourth an educational campaign among all the intelligent units directly in charge of labor, with the object of informing them of our methods and soliciting their cooperation in the care of their laborers

At first many difficulties were encountered The areas to be sanitated were vast there were many 'doubting Thomases' among the members of our personnel and there was a spirit of suspicion and distrust among the laborers and their families However the work was energetically pursued cooperation was gradually obtained the laborers were convinced of the benefits derived from early treatment and these measures soon began to show results The efficiency of the laboring population was increased and consequently their earning capacity enhanced This resulted in their becoming more contented as they felt better and with increased earnings were able to improve their standards of living This was reflected in lower production costs which convinced the administration officials that the efforts and extra expenditures incurred in connection with the campaign had been justified The intensive anti malarial campaign was started in the latter months of 1926, and the following table which shows the hospital admission rate for malaria per thousand employees per annum, gives a fair conception of the success of the campaign in the various divisions

For a variety of reasons better results have been obtained in some divisions than in others These differences are due in part to the dissimilarity in meteorological and topographical conditions in the various localities and in part to better cooperation in some divisions than in others

The conclusion is inevitable that it is financially profitable for industrial organizations in the American Tropics to sanitate the areas where they operate and to look after the welfare of their laborers

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THE ADMINISTRATION OF QUININE BY RECTUM IN THE TREATMENT OF MALARIA*

By K P A TAYLOR M D,†
Quirigua Guatemala

Difficulty in the oral administration of quinine is encountered in the following case types

(1) Those who object to the disagreeably bitter taste experienced when 30 or more grains are taken daily over a period of several days This taste is particularly noticeable in the early morning and renders food unpalatable

(2) Those whose gastro intestinal tracts are unusually sensitive to quinine In some individuals of this group irritation of the mucosa is

*Received for publication March 1 1930
†United Fruit Company Hospital

so severe that vomiting and even hematemesis are produced

(3) Those who are nauseated or vomiting from the true gastro intestinal form of malaria In the American tropics this group is of the greatest importance and the most frequent in incidence

(4) Unconscious patients usually suffering from the algid and cerebral types of malaria

(5) Individuals who are too ignorant indolent or prejudiced to persist long enough in the oral administration of quinine

Intravenous and Intramuscular Injection of Quinine—The dangers and disadvantages of these routes of administration are too well known to warrant discussion Marcy[1] in a report collaborating with the special committee of the Council of Pharmacy and Chemistry of the American Medical Association[2] has supported the view that the therapeutic action of quinine in malaria results not from direct contact of the drug with malaria plasmodia but rather through the medium of a metabolite formed by quinine decomposition or alteration in the liver and capillaries This committee confines its indications for the use of quinine intravenously to gastro-intestinal forms of malaria and to cerebral types The necrotizing action of quinine alkaloids and salts upon tissue has been fully discussed by Dudgeon[3] and Fletcher[4] Abscess formation necrosis severe secondary hemorrhage fatal septicemia and sciatic nerve paralysis have been observed by the writer to follow intramuscular gluteal injection of quinine and should relegate this mode of application to the most severe infections vomiting cases and unconscious and convulsive forms Unfortunately a large proportion of malaria cases applying for treatment in tropical America are of such severity that parenteral administration of quinine must be carried out, at least as an initial measure

Quinine by Rectum—A test of the rectal administration of quinine was decided upon in the hope of finding a therapeutic method which would make unnecessary intravenous or intramuscular quinine injection in vomiting patients and cerebral types Caution in selecting cases has not yet permitted a trial of the method in these case groups The excellent results obtained in treating a small series (eleven) of mild and moderately severe cases of malaria by the rectal instillation of quinine would seem to justify extending the trial of the method to more unfavorable cases

Past Experience—In the past many attempts have been made to effect routine rectal quinine administration but the method has found little favor because of the resulting burning irritation tenesmus and diarrhea and uncertainty as to the quantity of the drug absorbed

Wilcox[5] quoted by Ross[6] has estimated (clinically) that quinine administered by rectum is only half as effective as when given by mouth and that both of these methods are inferior in point of effectiveness to the intramuscular and intravenous routes. Suzuki[7] on the other hand reported that the minimal lethal dose of quinine administered by rectum to rabbits was 0 33 gram per kilogram while by mouth it was 0 66 gram per kilogram He habitually uses the rectal route in clinical practice administering daily 100 c c of a 0 5 per cent solution of quinine hydrochloride in water The results reported by Suzuki from this small dose (0 5 gram) given daily by rectum made a favorable comparison with cases treated by mouth Generally speaking they caused no uncomfortable local disturbances

It is clear that so small a daily dosage would not be effective in treating a majority of the malaria cases seen in native laborers of the Caribbean zone Furthermore larger quantities of quinine in watery solution have proven too irritating to the rectal mucosa The technic devised by the writer and described below has permitted the exhibition of quinine by rectum in large dosage without discomfort to the patient or inability to retain the medicament

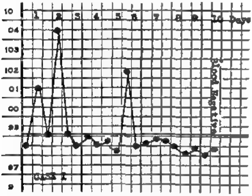
Effectiveness of Method—Infection by all varieties of malarial organisms as well as mixed infections have been successfully dealt with in this manner No case has failed to respond to treatment and in none has treatment been modified or supplemented by oral or parenteral administration of quinine (excepting in those cases receiving an initial routine dose of quinine by mouth upon admission and before the establishment of definite diagnosis) Furthermore clinical cure as well as elimination of parasites from the peripheral blood has been accomplished as rapidly and as effectively as by oral administration

CASE RECORDS

Ring forms are denoted O gametes C marked infection one plus heavy infection two plus severe infection three plus dangerous four plus. The designations are those of Mr L E Matthews Laboratory Technician Quirigua Hospital who made all blood examinations and reports as a part of the routine laboratory work

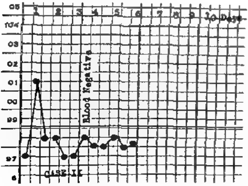
Case I—Case 77 age 34 a negro was admitted January 10 1929 to Quirigua Hospital He had pain in the back and left loin the condition was fair The blood smear was positive quartan ■ three plus He received 30 grains of quinine daily by rectum for eight days On the fifth day the blood smear was quartan one plus The second chill occurred the same day The temperature was normal on the seventh day The blood was negative on the ninth day He was discharged January 20 1929 He had not complained of tenesmus or irritation from treatment All injections were retained

Case I—Quartan ■ three plus



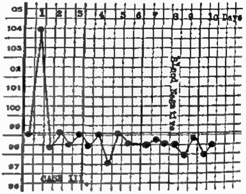
Case II—Case 398 Quirigua Hospital was admitted March 4 1929 He was 35 years old a native He had fever chills and headache for five days His condition was fair and spleen two plus Blood smear showed tertian O There were uncinaria ova in the stool He received 60 grains of quinine daily by rectum for four days His temperature was normal on the second day His blood was negative on the fourth day He was discharged March 9 1929 He had no tenesmus All *injections were retained*

Case II—Tertian O



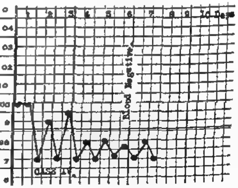
Case III—Case 3 5 Quirigua Hospital was admitted March 1 1929 He wa 21 years old a native He had *had fever for twenty days* He was discharged one month previously after treatment for cerebral malaria His blood was negative on discharge Blood smear showed tertian O two plu He received 60 grains of quinine daily by rectum for six days His temperature was normal on the econd day His blood was negative on the seventh day He was discharged March 10 1929 He had no tenesmus All injections were retained

Case III—Tertian O two plus



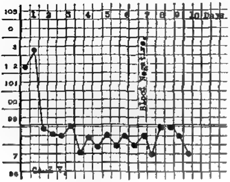
Case IV—Case 358 Quirigua Ho pital was admitted *February 26 1929 He was a 27 year old native He* had headache fever and pain in the back and pleen for four days His condition was fair Blood smear tertian O three plus He received 60 grains of quinine daily by rectum for five days His temperature was normal on the third day His blood was negative ■ the fifth day He was discharged March 5 1929 He had no tenesmus All injections were retained

Case IV—Tertian O three plus

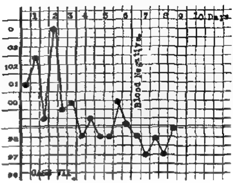


Case V—Ca e 134 a 20 year old white native was *admitted to Quirigua Hospital January 23 1929* He had had fever chills and nausea for two days His condition was fair Blood smear showed estivo autumnal forms ■ three plus C He received quinine 60 grains daily by rectum for even days The blood smear on the third day contained e tivo autumnal para sites O one plus C His temperature was normal on the second day His blood was negative on the sixth day He received a course of plasmochin after completing the rectal injections He was discharged February 3 1929 He had no tenesmus All injections were retained

Case V—Estivo autumnal O three plus C

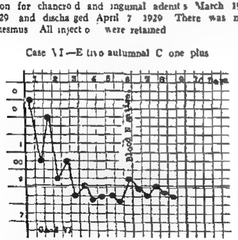


Case VII—Estivo autumnal O



Case VI—Case 269 a native age 24 was admitted to Quirigua Hospital February 11 1929 He had had fever for one week His condition was fair The blood smear contained estivo autumnal parasites C one plus He received 60 grains of quinine daily per rectum for four days His temperature was normal on the third day His blood was negative on the fourth day He was put on tonic tablets and plasmochin He was operated upon for chancroid and inguinal adenitis March 19 1929 and discharged April 7 1929 There was no tenesmus All injections were retained

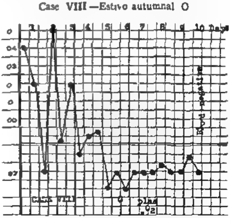
Case VI—Estivo autumnal C one plus



Case VII—Case 535 a native age 17 years was admitted to Quirigua Hospital March 27 1929 He had had fever and headache for one week His condition was fair His spleen was three plus The blood smear contained estivo autumnal parasites O He received 60 grains quinine daily by rectum for two days His temperature was normal and blood negative on the third day He was given a course of quinine and plasmochin (os) for six days He was discharged April 5 1929 There was no tenesmus All injections were retained

Case VIII—Case 321 a native age ■ was admitted to Quirigua Hospital February 21 1929 He had had fever nausea headache and pain in the back for four days His condition was fair His spleen was three plus The blood smear contained estivo autumnal parasites O He received 60 grains quinine daily by rectum for six days The temperature was normal on the fourth day The blood smear on the sixth day showed estivo autumnal forms C He was given three plasmochin tablets 0.01 gram each twice daily for four days The blood smear was negative March 3 1929 and he was discharged the same day There was no tenesmus He expelled the greater part of the second quinine injection

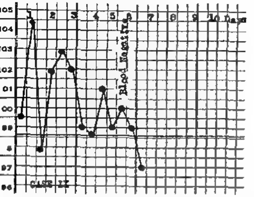
Case VIII—Estivo autumnal O



Case IX—Case 52 a native age 18 was admitted to Quirigua Hospital January 7 1929 He had had fever and headache for four days His condition was fair The blood smear was negative on admission The blood smear the second day contained estivo autumnal parasites O He received 45 grains quinine daily by rectum for six days His temperature was normal on the fourth day The blood smear was negative on the fifth day

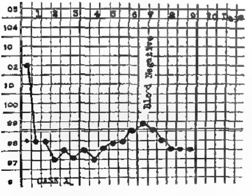
He was discharged January 13, 1929. He complained of slight tenesmus for two days. He retained all injections.

Case IX.—Estivo autumnal O.



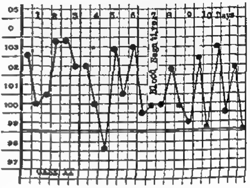
Case X.—Case 133, a native, age 25, was admitted to Quirigua Hospital January 23, 1929. He had had fever for two months and swelling of the right side of the neck. The blood smear contained estivo autumnal parasites O one plus and tertian O two plus. He received 60 grains of quinine daily by rectum for seven days. His temperature was normal on the second day. The blood smear on the third day contained estivo autumnal forms O and tertian O one plus. The blood smear on the sixth day was negative. The swelling of the neck subsided on the third day. The quinine course was followed by two tablets of plasmochin of 0.01 gram each three times a day for five days. He was discharged February 3, 1929. There was no tenesmus. All injections were retained.

Case X.—Estivo autumnal O one plus. Tertian O two plus.



Case XI.—Case 89, a native, age 14, was admitted to Quirigua Hospital January 13, 1929, with a mixed infection of malaria and miliary tuberculosis. He had had fever and a cough for [illegible] days and had been admitted three times previously for cerebral malaria. His condition was poor and he was stuporous. There were rales throughout both lungs. His spleen was four plus. His blood smear contained estivo autumnal O one plus, tertian O four plus. He received seven daily rectal injections of quinine, three of 45 grains and four of 60 grains. The blood smear was negative on the seventh day. The temperature was lowered on the sixth day. There was no tenesmus and all injections were retained. He died on the forty-ninth day. Autopsy showed acute general miliary tuberculosis and tuberculous meningitis.

Case XI.—Estivo autumnal O one plus. Tertian O four plus. Miliary Tuberculosis.



TECHNIC OF ADMINISTRATION

Upon admission and diagnosis the patient is given by mouth 2 ounces of a saturated solution of magnesium sulphate. Two hours later a soapsuds enema is ordered and an hour after expulsion of the enema 60 grains (average adult dose) of powdered quinine sulphate in 2 ounces of olive oil is deposited in the rectum. Doubt concerning the expulsion of the cleansing enema may be eliminated if it is desired by washing out the colon with water before giving quinine. The quinine mixture should be well stirred and shaken to ensure even emulsification. It is poured into a funnel connected with a large soft rubber catheter or rectal tube which has been introduced 3 to 4 inches into the rectum and allowed to enter the rectum by gravity. A rubber bulb syringe may be used. When the last of the emulsion has gone through the funnel the catheter is gently milked toward the anus to ensure deposition of the entire dose. The catheter is then withdrawn and the patient told to resist all inclination to defecation for six hours. If the colon has been well evacuated prior to treatment there is seldom any difficulty in carrying out this technic. Rest in bed is in most cases a necessity. In seriously ill patients it may of course be imperative that quinine be given immediately upon admission. The preliminary dose of magnesium sulphate may then be dispensed with, the patient receiv[illegible] enema

upon admission and the quinine enema as soon as the cleansing enema is expelled

After the first treatment is given the following routine is established one hour before the evening meal the patient is given 2 ounces of magnesium sulphate This will normally assure a complete evacuation before the patient has gone to sleep At 7 a m the following morning a soapsuds enema is administered and at 8 a m or after expulsion of the enema the quinine oil instillation is carried out In this manner sleep is not interfered with and the patient is able to devote his energy to the necessity of retaining the deposited dose of quinine for six hours During this period of the day he is easily kept under observation It is not necessary to restrict fluids during the six hour interval (although some patients find it more convenient to do so) and the dietary is not interrupted At 2 p m the patient is told that he is at liberty to evacuate his bowel Many find this unnecessary securing sufficient elimination from the nocturnal saline aperient and morning enema In this method of treatment quinine is administered only once during each 24 hours

RESULTS AND RATIONALE OF TREATMENT

Analysis of the cases reported indicates that quinine administered in the manner described compares favorably in effectiveness with its use by more conventional methods Although the rate of absorption and elimination has not been tested it appears probable that quinine emulsified in olive oil is absorbed slowly through the rectal mucosa and the lymphatic tributaries of the portal system Suggestive of this slow but regular assimilation of quinine is the fact that symptoms of cinchonism are often diminished in severity and are sometimes absent

No patients have been unable to carry out the treatment A few injections have been expelled These have been replaced quantitatively A single patient has complained of tenesmus and one of abdominal discomfort No instances of diarrhea or bloody stools have been noted

A probable advantage in treating estivo autumnal malaria by this method is furnished by the knowledge that estivo autumnal parasites sporulate to a large extent in the portal tributaries where they would be particularly exposed to contact with the quinine derivatives emanating from the pararectal lymphatics and venous sinuses

The fact that substances absorbed from the rectum (whether by venous channels or the lymphatic system) are conveyed to the liver may constitute an added advantage in hastening the development of the active quinine derivatives or metabolites Quinine absorbed from the stomach rapidly finds its way in part at least to the systemic circulation where its dissemination produces the symptoms of cinchonism

From a practical standpoint the method of treatment herein described has some merit in dealing with large numbers of ward patients Two well trained orderlies can carry out the treatment on a number of persons in a surprisingly short time

Plasmochin may be added to the emulsion By so doing anti malarial therapy may be reduced to a single daily dose of quinine and plasmochin The expense of olive oil (mineral or Wesson oil) must of course be added to treatment Ulcerative colitis anal fissure and inflamed hemorrhoids may be contraindications to any form of rectal therapy

CONCLUSIONS

(1) Satisfactory results in reduction of malaria temperature and elimination of parasites from the peripheral blood have been attained by the rectal administration of quinine in olive oil

(2) This method has not been employed in gastro intestinal or cerebral cases Selective use of the method in these and other grave forms of malaria is indicated if speed of action is not of primary concern and if adequate control of administration is assured

(3) Certain disadvantages and objectionable features of other methods of quinine administered are foreign to its use by rectum

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MALARIA AND HOOKWORM IN VENEZUELA*

By J R Ascanio-Rodriguez M D,
Caracas Venezuela

As a representative of the National Public Health Service of Venezuela, I have the honor and the pleasure of presenting to the National Malaria Committee and to the Southern Medical Association the greetings of my Government my people and our profession

I have been greatly interested in this meeting We have our malaria problems in certain parts of Venezuela

I shall summarize very briefly a few of my own observations and those of my colleagues

(1) We have sixteen species of mosquitoes that are said to convey malaria but none of those mosquitoes has ever been found naturally infected

(2) Experimentally Dr Benarroch has not been able to infect these mosquitoes

(3) I have found that malaria is nearly always in association with hookworm

(4) I have found the hemoglobin in hookworm disease often as low as 50 per cent If hookworm is eliminated the hemoglobin rises to 70 per cent and stays at 70

(5) Where concurrent infection exists the elimination of hookworm very often is followed by the disappearance of fever associated with malaria though the parasites are still to be found in the blood

(6) If we give daily injections of compounds of iron after the treatment for hookworm we find that when the hemoglobin reaches 90 per cent the malaria parasites disappear and I have never seen relapse where the hemoglobin is maintained at 90 or 95 per cent

(7) For nearly the last twenty years my Government has carried on over all the country a campaign against both malaria and hookworm This campaign has been extensively increased in the last year

(8) Recently we have been greatly aided by the scientific investigations of the Rockefeller Foundation an institution with which you are all familiar

*Remarks before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Third Annual Meeting Miami Florida November 19 22 1929

HOOKWORM AND MALARIA*

By Henry Hanson M D
Jacksonville Fla

"The literature of malaria is voluminous the contributions and text books by authority are few the lubrications of the tyro are multitudinous and probably over no disease has wrangling international and internecine been so considerable as over malaria," says Angus MacDonald.

It is however, with the hope of obtaining further information from a discussion of the subject by health officers and others interested in the problem that I present hookworm and malaria infection as factors which combine in causing poor economic conditions in rural districts along the Gulf Coast

My interest in these two diseases was stimulated while I was serving as a field medical officer in the Bureau of Communicable Diseases under the direction of Dr F A Brink in District No 5, comprising ten counties in the western portion of the State of Florida An opportunity was presented to compare the incidence of malaria in a portion of the United States which borders on the tropics with those with which I had had some experience in various portions of the tropics In a brief study made in West Africa I found that 80 per cent of children in the Idaban Ilorin Ado Ikiti area showed malaria parasites in a single thin smear examination The ages of the children examined varied between one month and ten years Sixteen per cent were infected during the first six months of their existence 41 per cent were infected before one year of age 66 per cent before they had passed the third year of life

The most interesting phenomenon noted in the examination of the African children was that of phagocytosis of red blood cells containing ring forms both in quartan and estivo-autumnal infections

The phagocytosis occurred in one child (Adejuwon) nine months old with estivo autumnal infection in one three years old with estivo autumnal infection in one six years old with quartan infection and in one eight years of age with quartan infection It appeared rather significant to find the phagocytosis in these natives none of whom had taken quinine or complained of illness Dr Clark of the Colonial Medical

*Read in Section on Public Health Southern Medical Association Twenty Third Annual Meeting Miami Florida, November 19 22 1929

Service, reported *(verbally to the writer)* that in a similar series he very seldom obtained positive smears from the blood of Nigerian adults My limited series from similar adults gave only 5 per cent positive malarial smears It appears that the native adult is immune to the local strain of malaria but not necessarily to that of the parasite on the east coast of Africa[3] Is it not plausible to ascribe the immunization to the phagocytosis which occurs among those who are not treated with quinine?

Erythrophagocytosis has been observed by Craig[4] in malaria and by Connal[5] in hematozoic infections but is not otherwise commonly mentioned in medical literature It is probable that if a more minute examination were made of blood smears phagocytosis would be more frequently seen

While we were conducting typhoid immunization clinics in the flooded areas along the Choctawhatchee and Yellow Rivers more than half of the people attending asked for some help in combating malaria Certain quacks had canvassed the country giving shots which they claimed were malaria preventive It appeared that these were inoculations of sodium cacodylate a good tonic but of no value as a cure or control for malaria The propaganda of the charlatans had created the erroneous notion that malaria might be prevented by inoculations as in the case of typhoid or diphtheria Many of the country people who came to the clinics did so because they believed the anti typhoid inoculations were prophylactic measures against malaria

Unfortunately it appears that the practice of physicians sometimes leads to the belief that both cure and prevention of malaria rests with the hypodermic Many persons showed arms scarred from abscesses resulting from quinine inoculations *While hypodermic medication is used to* a considerable extent in some parts of South America and to some extent among the colonials on the West Coast of Africa it is not the method of choice either for the cure of malaria or its *prevention The modern malariologists object* to the use of prophylaxis as applied to the control of the disease by administration of quinine Under conditions usually met in the tropics quinine control is often the only means available which enables the laborer or traveller to carry on without interruption by an acute attack of fever Under such conditions quinine should be taken by mouth (in West Africa 5 grains daily *is the prescribed dose)* and not by the needle

In order to obtain some data on the incidence of malaria in the subtropical portion of the United States comparable with that which I had obtained in the tropics I took 531 blood smears from persons of all ages attending the immunization clinics referred to above from persons living in and adjacent to the flooded areas along the Choctawhatchee Yellow and Escambia Rivers in West Florida The ages of those examined varied between two and seventy years The laboratory reported 58 per cent positive for parasites Five hundred of these smears were taken in two counties one of which has reported a mortality rate of 105 per 100 000 population and the other 164 which tends to harmonize with the survey finding One hundred and five of those examined were colored people mostly farmers The incidence of positives did not vary materially in either race

From observation of the children and many adults throughout this portion of the State it appeared that malaria alone was not the most serious condition Many persons showed marked evidence of hookworm infection

Examinations of the stools from children in various schools gave on incidence of infestation ranging from 50 to 80 per cent In one small school of 19 pupils and one teacher all showed hookworm eggs in the stools Even if one makes the distinction between hookworm infestation and hookworm disease as is done by the experts in this subject all are very important from the sanitarian s viewpoint It has been said by Darling Smillie and others that an individual may carry 30 or 40 worms without showing physical evidence of disease Ashford[6] says that one female worm may deposit as many as 9 000 eggs in 24 hours which would mean a soil pollution of 360 000 potentially infective larvae per day from each such individual What the number of infective larvae would be from one with active hookworm disease might run into staggering figures In an autopsy I recovered 150 worms from a piece of intestine about a yard *long These conditions graphically emphasize* the importance of isolation of the infective stools by the use of appropriately constructed privy vaults in rural communities.

It has been the purpose of this paper merely *to point out the importance of the two diseases* as coexisting factors affecting the economic conditions where they prevail In the counties where the conditions prescribed prevail the land

is good and farming would be profitable if the two diseases were controlled. There are no other deterrants to prosperity.

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DISCUSSION (*Abstract*)

Dr. V. H. Bassett, Savannah, Ga.—Dr. Hanson's figures presenting the percentage of infection are extraordinary and correspond to those often found in field surveys where malaria is especially prevalent. It is to be noted that these high percentages of infection were not secured by a systematic sampling of the whole population, and on that account they are all the more remarkable.

The persons who were examined presented themselves for another purpose and were selected for examination for malaria only on that account. It is true that they were in a flooded area, but they did not come on account of needing curative treatment.

I would like to ask Dr. Hanson to what extent he found malarial fever and hookworm co-existent and whether they presented any difficulties in the health administration.

Dr. Hanson's observation on the phagocytosis of malarial parasites is also very interesting. It is to be hoped that he will be able to continue these studies and explain something of the mechanism of the apparent immunity established in the adults living in a malarial district.

Dr. W. S. Leathers, Nashville, Tenn.—I wish to ask Dr. Hanson if he has any data relative to the degree of infestation from hookworm disease in the area referred to in his paper, and also whether he has information with reference to the number of people who have both hookworm and malaria. Might I inquire concerning the density of population in this area? These questions are asked from the standpoint of the economic aspects of the problem.

It seems to me there is a possibility of overemphasizing the use of plasmochin in malaria work at this time. As I understand it, the use of plasmochin from a therapeutic standpoint ■ rather in the experimental stage, and in view of the fact that there are methods for the control of malaria which are quite reliable, it is well to consider carefully whether it is desirable to use such a substance as a public health measure. In calling the attention of the public to a remedy of this kind we should be quite sure as to its value from a public health viewpoint. Of course, it is perfectly proper to use it in an experimental way in public health work, but I am referring especially to its use as a specific measure in a campaign for the control of this disease.

Dr. A. T. McCormack, Louisville, Ky.—I wish that Dr. Hanson would tell us something about the incidence of pellagra in this section. From economic reasons one would expect to find much pellagra here.

Dr. Hanson (closing).—The apparent incidence of pellagra was very low. About five patients said that they had pellagra, but the evidences were not definite and the symptoms not pronounced. They did not seem to be suffering severely from pellagra.

I hesitate to mention plasmochin because I have already noticed that there is a tendency to substitute plasmochin or quinine. I do not attempt to say that there is anything but quinine that will cure malaria. We know quinine has to be given in minimum doses of 10 grains three times a day over a long period of time following the initial vigorous treatment by 30 to 45 grains daily.

In my own personal experience in West Africa, I took 45 grains of quinine a day for about one week and then dropped down to ■, 10 and 5 grains, which was the therapeutic practice advocated there. The question that I hoped would be raised was whether 5 grains is enough for quinine control. Five grains is used by the West African colony; it is what they depend on to keep their people working, and those who used it did not take malaria.

My own attack developed while I was in the interior for three weeks after leaving off the control dose of 5 grains daily. An active soluble product is essential, such as the bimuriate of quinine.

MALARIA CONTROL BY USE OF PARIS GREEN: PRELIMINARY REPORT ON COUNTY WIDE WORK IN DOUGHERTY COUNTY, GEORGIA*

By T. H. D. Griffitts, M.D.,† Albany, Ga.

Location and Physiographic Features of Dougherty County.—This County is situated in the southwestern section of the State of Georgia, the western border being about thirty six miles from the Alabama line and the southern border approximately fifty miles from the northern line of Florida. It is bounded on the north by Terrell and Lee Counties and east of Flint River by a small portion of Worth County, on the east by Worth County, on the south by Baker and Mitchell Counties, and on the west by Calhoun County, from which county it is separated by the Chickasawhatchie Creek. The northeastern projecting corner of this County is separated from Lee County by the Flint River, which flows in a southwesterly direction to the City of Albany and thence south, through the County to form the boundary between Mitchell and Baker Counties. (At the extreme

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*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty Third Annual Meeting, Miami, Florida, November 19-22, 1929.

†Epidemiologist, U. S. Public Health Service.

southwestern corner of Georgia the Flint and Chattahoochee Rivers unite to form the Appa lachicola River in Florida) North of the City of Albany dams across Flint River and Mucka foonee Creek impound the waters of the river Muckafoonee Kinchafoonee and Muckalee Creeks for the hydro electric development of the South Georgia Power Company By this im poundage more than a third of the northern border area of Dougherty County now contains a large body of quiet water where formerly the water was contained in defined channels except at flood stage The total area of the County is 343 square miles or 219 520 acres The ex treme length of the County east and west is about 28 miles, while the extreme width north and south is approximately 12 5 miles The physiographic features of this County are rather uniform The greater part of Dougherty County lies within what is known as the Dougherty Plain as the mooth country of southwest Geor gia is designated * All of the County lies in this division of the Coastal Plain except the southern section The Flint River and Coolee wahee Creek divide the County into three prac tically equal areas extending from north to south or east middle and west sections That section lying east of Flint River is the smallest while the middle and west areas are of about equal size The middle area (between Flint River and Cooleewahee Creek) is further divided by the depression occupied by Percosin Creek the western area is traversed by Kiokee Creek with Tallahassee and Mud Creeks as its main tributaries Chickasawhatchee Creek borders the County for the entire distance on the west The general surface of this Plain is level undulating or slightly rolling The elevation varies from 190 to 215 feet above sea level

Lime Sinks —Outstanding features of the sur face of the County are the extensive and nu merous lime sinks ' more or less irregular de pressions varying in size from small areas to those occupying two or three hundred acres In the western section of the County the depres sions assume more of the character of swamps with sluggish streams Most of the lime sinks during a season of high rainfall become ponds of more or less constancy Many of the lime sinks do not contain water during a dry season or even in seasons of average rainfall However there are many important lakes and ponds in the southerly portions of the middle and west divisions of the county which are permanent bodies of water The swamps support growths of cypress bay tupelo and black gum smilax maiden cane (*Panicum hemitomum*) and other hydrophytic plants The shallow ponds gen erally support a rank growth of maiden cane

The natural drainage of Dougherty County is by four streams (and tributaries) running in a southerly direction namely Flint River Coo leewahee Kiokee and Chickasawhatchee Creeks (western boundary) The valleys of the creeks are generally wide and shallow while Flint River courses in a winding manner through the County in a channel 20 to 50 feet below the level of the highlands In many places almost level terraces border this River ranging in width from a few yards to a mile or more

Soils —The County is about midway between the fall line or the inner border of the Coa tal Plain and the Gulf Coast It is in the belt of red soils and all but two of them are sandy in character

They range in texture from light loose deposit of sand to a sandy clay loam and sticky plastic clay only slightly sandy at the surface While mo t of the soils are very andy at the surface all but a few grade into a friable sandy clay subsoil e ther within the three foot oil section or ju t below Generally this sandy clay in turn grades into a compact heavy matted clay also carrying some sand Several soil types besides being sandy also contain considerable quant ties of con cretionary gravel as in the eastern and west ern sections of the County and occasionally on each side of Flint River These gra el or pebbles are aggregations of l monite iron oxid w th and and clay impurities Bedrock is found all over the County at no great depth This consists ch efly of limestone.

Solut on of the limestone and the s nk g down of the overlying materials into lime sinks has formed one of the mo t con picuous topograph c features of the region and has an important influence on the deri a tion and formation of some of the so ls These limestones are of three different formations the Vicks burg the Chattahoochee and the Alum Bluff The Vicksbu g underl es the whole County e cept in the extreme eastern and southea tern part Along the east ern boundary the latter two format ons (Chattahoochee and Alum Bluff are found with the Altamaha or La fayette in the extreme southeaste n corner *

Climate —The southwest section of Georgia has long, warm summers and mild winters Sum mer weather conditions may last from March until November The mean temperature during this period is about 60° F for the end months and 80° F or a little higher for the midsummer

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Veat h Otto G l gy of the Coastal Plain f Geo gia. B ll No 26 Geological S rv y of Geo gia, p 39

Soil Survey of Do gh ty C unty G orgi U S. Departme t of Agriculture B reau f Soils, Washing t n Gov rnm nt Printing Offic Oct 17 1913

months the mean for July being 82 9° F Owing to relatively low humidity, the heat is not oppressive as in many other localities A temperature of 100° F may be reached repeatedly in the daytime but the nights are cooled by breezes from the south or southwest The extreme maximum temperature reached in 22 years was 106° F during July the extreme minimum was —2° F (only once) and otherwise the lowest recorded was *12° F* There are usually several days each winter when the temperature goes below the freezing point and these may be interspersed with balmy days The first killing frost u ually occurs about the middle of November and the last in the spring is about the first week in March Killing frosts have occurred as early as October 23 and as late as April 15 The annual average rainfall is approximately 50 inches Precipitation is fairly well distributed throughout the year, although the "growing season' usually has the greatest rainfall, while the months of least rainfall are the autumn months

The following tables show the temperature and rainfall records by months and departures *from normal with other climatological* data, for the years 1928 and 1929 for Albany Dougherty County (U S Weather Bureau data Albany, Ga Station)

It will be seen from the above records that in both 1928 and 1929 there was an excess of more than 15 inches above the normal annual *rainfall*

1928

Month	Temperature Degrees Fahrenheit: Mean	Departure from Normal	Highest	Date	Lowest	Date	Precipitation—in.: Total	Departure from Normal	Snowfall	No. of Days: With Precipitation	Clear	Partly Cloudy	Cloudy	Prevailing Direction of wind	Miscellaneous
January	47 6	—2 6	78	17	15	2	2 33	—1 74	O	9	19	6	6	N	Last killing
February	52 4	0 4	78	4	21	19	7 80	2 79	T	11	18	4	7	N	frost in Spring
March	60 6	0 1	89	29	38	3	3 78	1 06	O	13	15	0	16	SW	February 20
April	64 2	—2 6	86	26	41	1	12 96	9 38	O	8	20	1	9	S	
May	72 0	—2 5	95	18	45	9	1 48	—2 42	O	7	20	3	8	W	
June	79 8	—1 0	98	20	59	8	7 79	3 37	O	11	19	3	8	S	
July	82 2	0 1	96	3	69	7	4 02	2 14	O	13	20	3	8	SW	
August	82 1	0 5	97	4	70	22	7 98	2 41	O	17	13	0	18	S	
September	75 8	—2 2	94	1	50	25	9 67	6 45	O	16	16	2	12	SE	
October	71 5	3 7	89	6	45	25	1 27	—1 19	O	6	21	3	7	NE	
November	55 8	—2 1	81	17	28	27	0 81	—1 53	O	3	23	0	7	N	
December	51 1	—0 2	83	13	26	10	3 04	—0 73	O	7	0	4	7	N	First killing
Sums	—	—	—	—	—	—	64 93	15 69	T	117	224	29	113	N	frost in Fall
Means or Extremes	66 3	—0 7	98	June 20	15	Jan 2									November 21

1929

Month	Temperature Degrees Fahrenheit: Mean	Departure from Normal	Highest	Date	Lowest	Date	Precipitation—in.: Total	Departure from Normal	Snowfall	No. of Days: With Precipitation	Clear	Partly Cloudy	Cloudy	Prevailing Direction of wind	Miscellaneous
January	54 2	4 0	82	18	27	3	7 29	3 22	O	13	16	0	15	N	Last killing
February	52 4	0 4	81	27	29	12	8 13	3 12	O	11	15	5	8	N	frost in Spring
March	63 8	3 3	92	24	40	11	9 97	5 25	O	10	20	2	9	NW	February 18
April	72 0	5 2	90	6	47	17	3 74	0 16	O	10	18	1	11	S	
May	75 0	0 5	95	30	48	3	3 26	—0 64	O	14	19	3	9	S	
June	79 4	—1 4	99	21	37	5	4 34	—0 08	O	8	20	6	4	S	
July	81 2	—0 9	97	1	62	21	7 07	0 91	O	12	16	3	12	S	
August	82 4	0 8	98	24	66	29	5 20	—0 37	O	11	15	4	12	SW	
September	77 5	—0 5	95	12	55	20	3 73	0 51	O	13	14	3	13	E	
October	66 3	—1 3	85	8	41	26	5 47	3 01	O	4	25	2	4	NE	
November	60 1	2 2	87	3	23	30	2 74	0 40	O	10	14	7	9	NE	
December	47 4	—3 9	77	12	21	20	4 14	0 35	T	9	23	1	7	N	First killing
Sums							65 08	15 84	T	127	215	37	113	S	frost in Fall
Means or Extremes	67 7	0 7	99	June 21	21	Dec. 20									November 30

For the first four months of 1928 there was an excess of 11 49 inches In 1928, May and July were relatively dry months while June August and September were wet In 1929 May June and August were slightly dryer than normal while July and September were less than an inch each above normal in rainfall However the summer in each year had sufficient rainfall to keep many of the ponds filled by the early season a heavy rainfall to higher stages than usual During these same months the departures from the normal mean temperatures were 1928 minus 4 7 and 1929 plus 12 9 From May to October inclusive the mean temperature was very nearly normal in 1928 May June and September falling below normal while July August and October were somewhat higher plus 0 1 0 5 and 3 7 respectively From May to October 1929 inclusive June July September and October falling below normal and May and August higher plus 0 5 and 0 8 respectively

Population—The estimated total population of Dougherty County is 25 000 of which 11 000 are white and 14 000 negroes Of this population the City of Albany (the only incorporated town in the County) has 8 900 white and 9 600 negro inhabitants The rural population is fairly well distributed over the County although clustered at such settlements as Acree Putney Pecan City Pretoria Locketts Walker Station Ducker and Gillionville Dougherty County was early occupied by large plantations and a prosperous people Today there are relatively few plantation homes while in many parts more or less dilapidated or vacant tenement houses remain Pecans and cotton are the principal crops while peanuts are extensively grown and diversified farming is becoming more extensive

Malaria—Malaria undoubtedly has occurred in endemic foci in the County from the early settlement Scarcely anything else could account for the lack of agricultural development in Dougherty County or could paint the drab picture of inactivity existing in many parts The prevalence of malaria to a serious degree having been acknowledged by the people in general the business and civic organizations and the importance of malaria control stressed by the Georgia State Board of Health year after year the Board of Commissioners of Dougherty County levied a one mill tax in 1929 for the purpose of carrying on malaria control This tax yielded approximately $17 000 00

Blood Index—Blood specimens (thick) were taken from 1680 school children (primary grades) in the City of Albany and in the rural sections of Dougherty County April 10 17 1929 with the following results

		No Ex	No Pos	% Pos
City white schools	(4)	750	15	2 0
City colored school	(5)	596	31	5 2
Rural white schools	(2)	22	1	4 5
Rural colored schools	(15)	312	134	42 9
Rural white and colored schools	(17)	334	135	40 2
City white and colored schools	(9)	1346	46	3 4
Total white and colored schools	(26)	1680	181	10 8

The above established spring index represents carried over cases from the previous season It is a high rate of infection Another index will be taken at the same time in the spring of 1930 and in succeeding years as a measure of results of control efforts Also indices are to be taken after the opening of schools each fall In uncontrolled areas the fall index should present a higher rate of course than the early spring index

Control Measures—The Dougherty County Board of Health employed a field director for malaria control and he entered upon duty April 10 1929 No detail survey had been made of the County in order to locate the Anopheles breeding places The only map of the County available was the soil survey map which showed the lakes and large ponds The first problem was to find the important breeding areas and locate them on a map Only a month could be devoted exclusively to this before control operations were to start The malaria control division of the Georgia State Board of Health Mr L M Clarkson in charge and the United States Public Health Service through Surgeon L L Williams Jr in charge of Field Investigations of Malaria agreed to the establishment of a field station at Albany to act in an advisory capacity to the local control organization and for the purpose of conducting research in control methods and allied subjects The writer was detailed in charge of the station the other Public Health Service personnel being one sanitary engineer a clerk and an attendant

The method* of control determined upon was the application of Paris green at ten day periods to all located important *Anopheles quadrimaculatus* breeding areas For this purpose the County was divided into three districts of about equal areas with the inter-district lines extending north and south A foreman with three men equipped with hand power dusters and other necessary equipment, was placed in charge of each district Motor trucks were used for transporting men and material the foreman acting as driver for each outfit The larvicidal mixture used was a 15 per cent (by volume) of Paris green (known to have satisfactory lethal qualities) in hydrated lime The aim was to apply three fourths pound of Paris green to the acre of water surface It was early found that *hand mixing of Paris green* and lime was not satisfactory so a standard mechanical mixing machine was installed In addition to the three hand dusting gangs the County also operated one motor boat outfit operated by two men with motor truck for carrying the boat and other equipment The boat used was of metal flat bottom 14 foot length 48 inch beam and 24 inch depth equipped with a sea horse 3 2½ horse power outboard motor The power dusting outfit was made up of a hopper for holding the mixed dust a 'homelite generator a power dust gun and hose and wiring attachments One man operated the boat and the other handled the power duster This outfit was employed on the larger ponds and lakes *The South Georgia Power Company operated* a similar unit and also did hand-dusting on their body of impounded water The application of Paris green was made throughout the season of 1929 from May 16 until the latter part of September when for several days high winds interrupted the work

Costs —The distribution of costs on the first season s operation (April 10 October 1) was as follows

Salaries and wages	$3184 97
Transportation	1456.31
Equipment	1027 32†
Materials	2273 97
Incidentals	14 54
Total expenditures	$7957 [illegible]

LePrince J A and John on H A D velopment of a Power Dusting Device for Applying Pa G n as an An ph line Larvicide Rep int No 1 80 pp 1001 1017 P H.R. April 5 1929

†Four second hand truck from the County Farm were transferred to this wo k and only the motors in them were purchased from the malaria control fund.

Results —It is too early to evaluate accurately the control measures at this time It may be stated however, that owing to the fact that a close survey had not been made prior to the beginning of du ting operations, for the purpose of locating all important breeding places of *Anopheles quadrimaculatus* many specimens of this species continued prevalent in several of the catching stations located in various parts of the County There were 34 of these stations— *mule barns occupied houses* hollow trees privies barrels fowl roosts No records were available as to the degree of infestation during previous seasons The catches of imagoes in the stations (weekly catches) varied from zero in many stations to 616 (the highest single catch) The station known as Silver Lake Barn' ran high throughout the season with the count never running lower than 241 specimens Prior to the inauguration of dusting it was estimated that on one occasion there were 5 000 *A quadrimaculatus* resting in this stable With thorough location of additional breeding places in the County it is hoped that reduction of *quadrimaculatus* will be to a more satisfactory number during the second season A blood index will be taken in April 1930, for a measure of the effects of one season s work on malaria reduction A fall index has already been taken and showed the following results as compared with the spring index in [illegible] white and colored schools in the rural sections of the County

SPRING INDEX

No Examined	Positive	Rate
424	136	32 1

FALL INDEX

No Examined	Positive	Rate
372	120	32.3

It will be seen that the rate of increase was only slight (0 2 per cent) whereas in other malarious sections of Southwest Georgia during the past season malaria is estimated to have increased approximately 30 per cent It is only fair however to await the spring index for trustworthy comparison

In conclusion, it should be stated that there is no spectacular reduction in malaria anticipated as an immediate result of the measures applied in one season We are confronted with a relatively high rate of chronic malaria in Dougherty County Even total extermination of the vec

tor in one season's operations would not result in an appreciable decline in the morbidity rate in one season

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DISCUSSION (*Abstract*)

Dr J A Ferrell New York N Y—Malaria control in the Southern states was conducted for about four years (1920 1924) in the towns where the population was dense and the property value sufficient to render drainage and other anti larval measures economically practicable Since 1922 efforts have been made to extend control measures to the rural areas or on a county wide basis In certain instances the success of these attempts has been notable but in general the work has not been consistently and intensively carried out The economic factor is a serious obstacle Further study for evolving methods and further stimulation to have improved methods applied will be necessary if the disappearance of malaria from the Southern states is to be greatly hastened through the activities of the health departments

Mr L M Clarkson Atlanta Ga—We have five counties that are using a combination of Paris green application and drainage for mosquito control I believe we are working toward a solution of our problem on a county wide basis

In one county recently the commissioners decided that draining of ponds was more important than the building of highways so appropriated $10 000 00 for it

We believe that 1929 will be marked as the year in which county wide mosquito eradication was initiated and that the future looks brighter for the conquest of malaria

Dr Noble A Upchurch Jacksonville Fla—We have not discussed controlling the tide water streams

Our tide water streams are full of water hyacinths Hyacinths of course are developing in the fresh water streams and coming down and the tide carries them back to the smaller streams

We Southerners are badly in need of a realignment of the financial system for our malaria work We have educated our lawmakers to some extent but we do not get enough money for the malaria work

Mr Howard R Fullerton Nashville Tenn—I should like to ask Dr Griffitts if he is doing any screening work in connection with the malaria control work

Dr Griffitts—None whatever We desire to be able to evaluate this one method We shall take a blood index next year and shall not be able to measure the results until we take it

Dr Harry M Grant Richmond Va—It is a remarkable thing that you have a county which will devote $17,000 00 to this work alone What plan have you for the future? Did you propose that sum as an indefinite expenditure or what is the final objective?

Dr Griffitts—The State Board of Health hopes to reach the point where the county will drain what can be successfully and economically drained There is no question about this work going on from year to year but there may develop objections to its continuance indefinitely If there were a certain amount of drainage that would cut out the amount of temporary work now necessary we feel the people would be better satisfied in the long run and it would be a job that would last and we have suggested to the county board to do a certain amount of drainage to get rid of important breeding places especially within flight range of the City of Albany not to be dependent year after year entirely on applying Paris green

Dr Ferrell—What do you think it would cost to control the dangerous Anopheles in Dougherty County?

Dr Griffitts—I estimate $12 000 00 a year for a population of approximately 26 000

Dr Ferrell—What is the assessed value in that County?

Dr Griffitts—Approximately $17 000 000

Dr C A Mohr Mobile Ala—Have you any information on the probable dangers of Paris green for live stock?

Dr Griffitts—We started the season's work by announcing in the paper two or three times very forcefully that Paris green would not kill anything but wiggle tails that it would not kill anything even as sensitive as young shrimp larvae We had not one single complaint of illness or death of live stock By the end of the season no one doubted that Paris green was reducing mosquitoes and not destroying anything of value

Dr B J Lloyd Washington D C—Since I have been connected with the Pan American Sanitary Bureau (and by the way it is through the Pan American Bureau at the request of Mr LePrince that these foreign guests are here today) I have wanted to know how to answer questions I am often asked One is when one of our people of the United States goes to another country where there is malaria can he take quinine as a prophylaxis How much and at what times?

Are you using plasmochin and if so what is it doing for you?

Dr W E Deeks New York N Y—Mosquitoes can be infected when fed on malaria carriers who are taking full doses of quinine That question has been solved beyond doubt Apparently no amount of quinine will prevent mosquito infection Neither will it prevent infection in man What it does is to cure by destroying the parasite after it has begun to develop in the red blood corpuscle We do not believe that quinine destroys the parasite in its sporozoite stage

So taken in sufficient dosage quinine will destroy the parasite after it has begun to develop but it does not prevent infection Fifteen grains of quinine daily will prevent the development of malarial symptoms and keep a man at work in the Tropics while exposed to malaria infection However when he returns to the States and stops taking quinine he often comes down with the fever

There is another point which is often misunderstood. Plasmochin as far as we know at present is of some value in the treatment of benign forms of malaria, but we have found it absolutely of no use in the malignant type So far as we know at present its greatest value is in malaria control work. Given in small doses of 2 centigrams a week to carriers of sexual parasites it will prevent mosquito infection Barber and Komp and Whitmore showed that batches of *Anopheles albimanus* fed daily on crescent carriers who were taking small doses of plasmochin failed to develop oocysts in a single instance whereas before taking the

plasmochin and while on quinine only the mosquitoes fed on them showed a high percentage of infection

We have been u ing Paris green now for several years in all the United Fruit Company Tropical Divi sions in a 1 to 100 dilution with dust and no instance of its toxicity to man or bea t has been reported to us

I should like to make a further suggestion on malaria control measures which I consider very important In one of our Divisions we attempted control with quinine and plasmochin neglecting to a great extent the anti mosquito work The method was a failure although much care was exercised in making frequent blood sur veys of all camps and treating the carriers This goes to prove that in addition to this work it is necessary to do short range mosquito control for 300 to 400 yards about habitations and this control must be maintained Furthermore it is not practicable nor economical to have sanitary inspectors continually at work with gangs of men dusting We demonstrate to our intelligent per sonnel in charge of labor the methods of control and get their cooperation in taking up the work themselves and continuing it with their local farm personnel and have trained sanitary inspectors who make frequent visits to each farm keeping in touch with and advising them Labor quarters are daily inspected by those in charge of labor and the sick found in camp are given 30 grains of quinine daily and two tablets of plasmochin compound once or twice a week The quinine is con tinued for four days after which if the fever has not subsided the patient is sent to the hospital if it has quinine is kept up for two days along with two tablets of plasmochin once or twice a week Then a modified Aiken s tonic tablet which contains 2 grains of quinine is given to be taken three times a day as a follow up tonic treatment

Malaria control should be considered a community problem and we are endeavoring with a fair degree of success to place the responsibility for its control on the intelligent heads of farm operations from the su perintendent of agriculture on down to the overseer and timekeeper In areas where there are a large num ber of Anopheles breeding swamps near habitations which cannot be economically drained or filled the only protection we can offer is to educate the people to protect themselves by screening and the use of nets You cannot control the disease with quinine and plasmo chin

We have reduced our hospital malaria rate through out all the Divisions where we operate from 240 to 80 per 1 000 by the methods I have just outlined Every individual owner of a farm or dwelling should be made responsible and his attention should be frequently drawn to the locations of mosquito breeding places and each man should be compelled to take care of his own bailiwick

In our Cuban Divisions the employee ho pital mala ria rate for 1929 has run about 37 per 1 000 whereas formerly it ran from 300 to 400 per 1 000

Malaria control is not a sanitary question alone it is an individual problem for every intell gent unit and should begin by education Start with the school chil dren show them mosquitoes and larvae and explain the various stages in their development from the ova and the reasons for certain selective places for breed ing When the children are taught along these lines they take the message home to their parents and grow up with a knowledge of this work That is the only way that we shall succeed in controlling malaria for it is a problem of sanitation and education which must extend throughout the Country Malaria may be con trolled not by sanitation alone but with the coopera tion of every individual in the malarious region

Dr Henry Hanson Jacksonville Fla—The Chief Sur geon for the Antiochial Railroad in South America told me that the malaria rate among the railroad employees was reduced from 25 per cent to about 5 per cent after the systematic admini tration of quinine was be gun

At the Tropical Oil Company s hospitals Dr Kimmel told me in the early days there was a malaria admis sion rate of about 1 500 of employees before quinine prophylaxis among the employees was begun It then dropped to about 250 in 1924

Dr M A Fort Bainbridge Ga—During February 1929 the Winthrop Chemical Company gave me a lot of plasmochin compound tablets for experiment I per suaded about 50 prolonged malaria cases to come to my office every Saturday for examination and treat ment I gave the tablets as advised by the Company that is six tablets a day for adults and children in proportion I noticed the following

All symptoms promptly disappeared A number who had been semi invalids for many months and who claimed to have taken hundreds of capsules of quinine returned to work in a week They were enthusiastic about their improvement and their color improved

Both schizonts and gametes promptly disappeared from the blood Nearly all spleens decreased in size rapidly some of them going from four to six fingers-breadths below the costal border to normal in a few weeks

My experience coincided with that of Dr Miller of Waynesboro Georgia who found old quinine fast cases improved wonderfully under the plasmochin compound treatment The reduction in the size of the pleens certainly seemed to be more prompt and greater than I have ever been able to secure with quinine alone I added quinine to the treatment however and each pa tient got more quinine than that in the tablet

Nearly 20 per cent of those who took this treatment more than a week developed blue lips In those cases we su pended treatment until they were normal and began again with half the do e or less Toward the last I gave no one the full dose for it looked too dangerous If you play with plasmochin in large doses you will have some very blue patients

In Georgia the quad mo quito does not usually breed in freshly dug brick or borrow pits In fact it is often years before this happen It seems that in a dug out pit oil must wash in and growth appear like that of a natural pond before the quads find it suitable for their development

Dr G ffitts—As to Dr Lloyd s questions I think there is a rather general agreement that so called prophylactic quinine fails to prevent malaria infection but may mask the symptoms So far on this Dough erty County work we have not administered pla mo chin

FURTHER OBSERVATIONS ON THE MALARIA PROBLEM OF WEST TENNESSEE*

By Henry E Meleney M D
Nashville Tenn

Eugene L Bishop M D C P H
Nashville Tenn

and

Frank L Roberts M D
Trenton Tenn

The first intensive studies of the malaria problem of West Tennessee were made in 1928 and have already been reported[1] This paper is in the nature of a progress report and deals with the results of the summer studies of 1929 The work is a cooperative effort of the Tennessee State Department of Public Health and the Department of Preventive Medicine of Vanderbilt University The United States Public Health Service has also contributed to the program by studying methods and costs of dusting with Paris green Their study will be reported separately

INTENSIVE STUDIES IN DYER COUNTY

Dyer County was selected for intensive study because (1) it was shown last year to have a significant malaria problem (2) it has a well organized full time county health unit and (3) it has good roads even in the bottom land sections of the County The program of study in Dyer County included

(1) Recording the outline of the flooded portion of the County at weekly intervals until the Mississippi receded within its normal banks

(2) Locating on a map all the important potential breeding places of *Anopheles quadrimaculatus* in the County

(3) Catching adults and larvae of *A quadrimaculatus* at designated stations throughout the breeding season

(4) Making surveys of certain communities to determine the amount of malaria present and the Anopheles population of the houses

(5) Making blood surveys of all the schools of the County in the spring and late summer

A laboratory was established in Dyersburg from which the observations to be reported were made

FLOODED AREA

The first rise of the Mississippi River to flood proportions this year reached its peak in Dyer County about April 11 when 198 square miles of the County were under water By April 25 this had receded to 101 square miles but rose again to 212 square miles on May 23 This represents 42 per cent of the total area of the County On May 30 about 200 square miles were still flooded but one week later June 6 the Mississippi River was back within its normal banks Three small patches of low land totaling about five square miles and other stretches along the Obion and Forked Deer Rivers were all that remained under water on that date Such a rapid receding of the flood is not uncommon in the Mississippi Delta but the peak of the flood is usually reached in March or April rather than late in May Considerable Anopheles breeding took place this year before the flood receded and this undoubtedly caused an increase in the size of the early crop of quadrimaculatus adults

QUADRIMACULATUS BREEDING PLACES

The mapping of the important breeding places of *A quadrimaculatus* and all permanent bodies of water and streams was done as time permitted during the summer The United States Public Health Service group is responsible for much of this work The drying of shallow pools in the bottom land during the mid summer drought makes the estimation of the area of such places rather indefinite However as they usually contain many Gambusiae and are almost free from floatage or vegetation after receding from their grassy borders they are rarely found to contain mosquito larvae and are probably not important breeding places The following approximate measurements have been made from the map prepared to show potential breeding places

DATA FROM MAPPING OF DYER COUNTY

Ponds, sloughs and creeks in bottom area	14 sq mi
Rivers with banks which may breed Anopheles when flooded (Obion and Forked Deer Rivers) length of both banks	210 miles
Graded roads in bottom having borrow pits length	64 miles
Artificial drainage ditches length	100 miles

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*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Third Annual Meeting Miami, Florida November 19 22 1929

From the Tennessee State Department of Public Health and the Department of Preventive Medicine and Public Health, Vanderbilt University

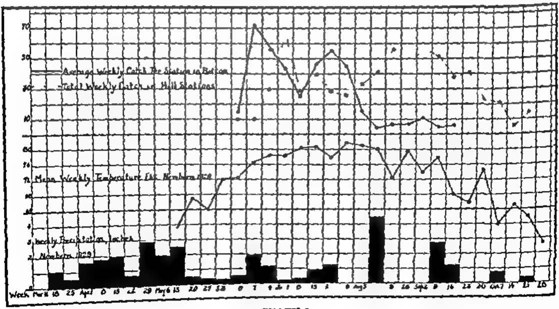
Hill streams length	125 miles
Borrow pits along hill roads length	17 miles
Borrow pits along railroads	Not investigated

This probably represents the minimum amount of area in ponds and sloughs which would need treatment of some kind, and the maximum amount of river shore line, creeks hill streams drainage ditches and borrow pits Artificial drainage ditches should not be dangerous if their grade is kept even and their channels free from obstruction Borrow pits along hill roads and railroads should be drained by the responsible authorities so as to make mosquito breeding impossible Hill streams may offer special problems because of their irregularities and side pools They require further study The treatment of breeding places in the bottom land is considered in the report by the United States Public Health Service workers

ANOPHELES CATCHES

Catching stations for both larvae and adult Anopheles were established throughout the County About 60 per cent of Dyer County is hilly and 40 per cent bottom land The stations in the hill section included places along the Obion and Forked Deer Rivers which were much like the bottom land The hill stations were visited by a county sanitary inspector and our records are based upon specimens caught by him and brought to the laboratory The stations in the true bottom land were visited by members of the laboratory staff In these stations it was considered more accurate to count the adult mosquitoes than actually to catch them The difference between these methods would tend to make the numbers recorded from the hills lower and more uniform than those from the bottom land Nevertheless, the results give interesting information on the progress of breeding in the two areas

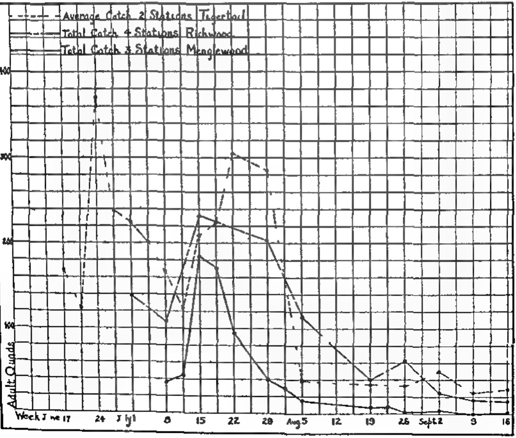
Graph 1 contrasts the results of the adult catches in the bottom land with those in the hills and shows the relation of both to the mean weekly temperature and weekly precipitation as reported at the United States Weather Bureau station at Newbern nine miles northeast of Dyersburg Since the counts in the bottom land stations were always much higher than the catches in the hill stations, it has been necessary, for graphic purposes to chart all the *quadrimaculatus* adults caught in the hills each week but only the average number per station from the bottom land This brings out the trend of breeding in the two areas It will be noted that the largest numbers of *A quadrimaculatus* appeared early in the summer during the week of June 17 in the bottom land and two weeks later in the hill section The cooler water of the running streams in the hills apparently de-



GRAPH 1
Observations of adult A quadrimaculatus in catching stations in the hills and bottom land of Dyer County plotted against the temperature and rainfall

layed the development of adults there. The second point of interest is the sudden decrease of mosquitoes in the bottom land stations coincident with the greatest heat and a period of two weeks *without any rainfall*. *During this* period most of the borrow pits and ponds which *had remained after the flood dried up completely.* A week with very heavy rain then followed but three more weeks with practically no rain again dried up the pools so that no great increase of *A. quadrimaculatus* occurred. The third point of interest is that there was no decline in catches of adults in the hill stations coincident with that in the bottom land but an actual increase to double the former number. This would seem to indicate less drying up of the hill breeding places associated with running streams.

Graph 2 shows a comparison of the trend of the catches in three different groups of stations in the bottom land namely Menglewood, Tigertail and Richwood. In the Menglewood area the United States Public Health Service group applied Paris green every ten days to two weeks beginning July 10. In the Tigertail area dusting was first done July 16 to 20 and again August 9 to 15. In the Richwood area no dusting was done. It will be noted that all three groups of stations shared in the rapid decrease in the number of mosquitoes at the beginning of August. The Menglewood stations however fell off earlier than the others and remained at a very low level. The Tigertail stations in which the mosquitoes were most numerous, fell off even more abruptly but not until the first of August and remained at a somewhat higher level. The Richwood stations fell off more grad-



GRAPH

Amount of A. quadrimaculatus in three groups of catching stations in the bottom land of Dyer County

Table 1
Malaria Survey of Communities Lakes and Dyer Counties July and August 1929

District	Date of Survey	Homes Examined	Homes Containing A. quadimaculatus	Ave. number female quads per house	Number of Histories Taken	Positive Malaria History 1928 or 1929	Number of Spleen Examined	Enlarged Spleens (P or larger)	Number of Blood Specimens	Blood Specimen Positive	Classification of Positive Spleens PDI	P	1	2	3	Location Of District
Richwood Dyer County	July 15 18	34	88	13	139	62%	66	55%	147	24%	—	9	19	4	4	In bottom land South of Obion River
Menglewood Dyer County	July 24 26	22	95%	12	111	75%	61	56%	127	52%	—	1	21	9	3	In bottom land on Obion River
Lenox Dyer County	Aug 5 9	27	87%	7	144	51%	115	35%	210	22%	1	10	21	8	1	On edge of bottomland
Cottonwood Lake County	Aug 15	24	88%	7	88	73%	56	59%	119	33%	6	11	14	6	2	In bottom land often submerged
Hathaway Lake County	Aug 16	8	50%	[illegible]	35	77%	3	65%	51	10%	[illegible]	8	5	2	0	In bottom land near Mississippi River
Madie Lake County	Aug 12	14	43%	[illegible]	86	49%	49	20%	103	10%	8	7	3	0	0	Higher part of bottom land rarely submerged

ually and maintained a relatively higher level than the others throughout August

COMMUNITY SURVEYS

Dyer County—Complete malaria surveys were made in three areas The results are shown in the upper half of *Table I* The Menglewood area consists of a compact village built on high piles adjacent to a now abandoned box factory together with the surrounding farming region close to the Obion River Our evidence indicates that it ■ the most malarious community in West Tennessee Richwood is a purely farming area of scattered houses in the bottom land half way between the Obion and Forked Deer Rivers Its lower malaria rate is doubtless due to its distance from these rivers Lenox is on the edge of the hill region and is crossed by several creeks running into the bottom land It has considerably less malaria than Richwood The Anopheles population of the houses in the three communities ■ in proportion to their proximity to breeding places and to the amount of malaria present It ■ expected that these communities will be used in the future in estimating the efficacy of anti malaria measures especially the use of Paris green The present surveys will serve as a basis for comparison

Lake County—The three communities which were surveyed ■ 1928 were resurveyed this year and the results are given in the lower half of *Table I* for comparison with the Dyer County surveys Cottonwood has the highest school malaria rate in Lake County but apparently is less malarious than Menglewood in Dyer County The other two Lake County communities show a correspondingly lower incidence than those of Dyer County In *Table II* the Lake County surveys of 1928 and 1929 are compared Most of the homes in these communities have now been screened by the County Health Department and a few have also been further mosquito proofed by papering the interior There is no change in the percentage of houses containing *quadrimaculatus* mosquitoes but the number per house in the Cottonwood district is only half what it was last year This reduction is probably due to the screening Although there is a slight decrease in the percentage of positive blood, this is within the range of error in such a survey and one cannot state that there has yet been any reduction in malaria Obviously thorough mosquito proofing is necessary before these homes will be protected and vigorous educational measures will have to be taken before the malaria rate can be greatly diminished

TABLE 2

Malaria Survey of Communities Lake County 1928 and 1929

D[illegible]	Year	Houses examined	Houses well [illegible]	Houses [illegible]	Houses with [illegible]	Houses with Anopheles q[illegible]	A[illegible]	Number [illegible]	Bl[illegible]
Cottonwood	1928	15	1	0	?	87%	14	83	40%
	1929	24	17	4	17	88%	7	119	33%
Hathaway	1928	8	?	[illegible]	?	63%	?	56	18%
	1929	10	10	3	4	50%	2	51	10%
M[illegible]d	1928	20	?	0	?	20%	?	108	15%
	1929	15	14	?	?	40%	2	103	10%

Henning Farm—This farm in Lauderdale County was entirely screened in 1928 but complete mosquito proofing of the houses was not finished until October 1929 It was found this year that the screens had not been well cared for although this could be enforced by the farm manager Dr R ■ Griffin the County Health Officer carried on a vigorous treatment campaign on this farm in the summer and autumn of 1928 and the farm manager reports that practically no time was lost by the farm hands during the cotton picking that year A blood survey of the tenants in August 1928 gave 22 per cent positive for malaria A second survey on May 30 1929 gave only 5 6 per cent positive but a third survey on November 25 1929 again showed 18 4 per cent positive The normal seasonal variation apparently accounts for the spring drop The screening and treatment has so far not materially affected the incidence of malaria on the farm The complete mosquito-proofing which has just been completed should show its value next year Educational measures on the use and preservation of screens will be carried out and energetic treatment will be continued during 1930

SCHOOL SURVEYS

A total of over 22,000 blood specimens were collected in the school surveys in West Tennessee this year The examination of the specimens from Obion Lauderdale and Shelby Counties has not yet been finished The results from Lake, Dyer and Tipton Counties are as follows

Lake County—Four school blood surveys have now been taken in this County and the results are shown in *Table III* The result of the 1929

TABLE 3

Lak County Sch l Bl od S y 1928 nd 1929

Date	N mb f Sch ls	Numb f Specimens	Numb P n e	P r Cent P sit e
M ch 1928	22	909	101	11 1
Septemb 1928	23	843	116	13 8
April, 1929	14	874	48	5 5
S p mb 1929	21	952	159	16 6

Thi i p b bly n p ntati f th wh l county since al of th sch l sh wing h gh p ntag w not n b caus of th flood

summer survey corroborates the general impression that there has been more malaria in West Tennessee this year than there was last year As was to be expected the screening campaign in Lake County has not as yet affected the amount of malaria there, since most of the houses are poorly constructed and must be mosquito proofed by papering and other measures before they will protect the inhabitants

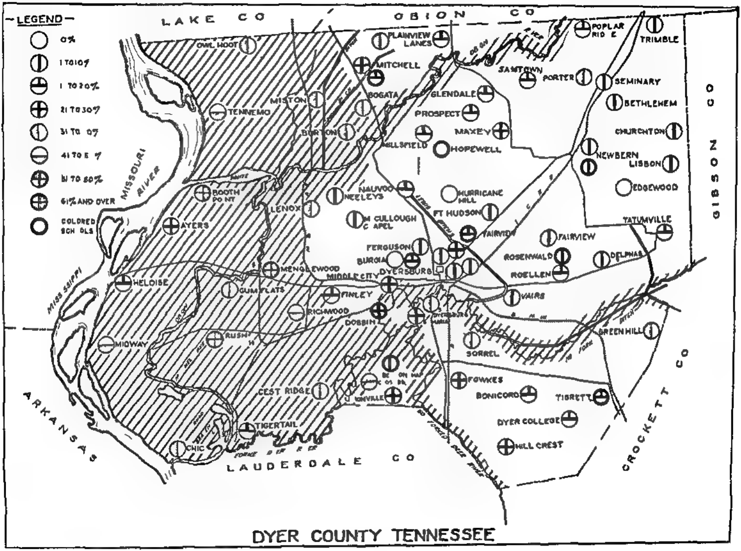
Dyer County—School blood surveys in this County were taken in March and August of this year *Table IV* shows the results of the two surveys The spring survey is not representative of the whole County, since the schools with highest malaria incidence were not in session because of the flood The fact that the summer survey of these same chools yielded 14 7 per cent positive bloods indicates that the malaria problem is by no means confined to the actual bottom land The high figure of 32 3 per cent positive in the bottom land schools emphasizes the severity of the problem there and indicates that Dyer County has the most serious malaria problem in the State This County consisting of both bottom land and hill country, has a total blood rate as high as Lake County which consists only of bottom land, and the bottom land of Dyer County has an incidence nearly twice that of Lake County *Map I* shows the location of the schools, their malaria incidence and their relation to the area actually submerged at the height of the flood this year Since about 20 per cent of the population of the County live in the bottom land there is ample reason for instituting vigorous measures to control the di ease

Tipton County—A blood survey of 28 schools was made in August 1929 for the purpose of getting a preliminary estimate of the severity of the malaria problem This County has only a narrow strip of bottom land along the Mississippi River and is separated from Lauderdale County on the north by the Hatchie River, whose valley is subject to overflow when the Missi sippi is in flood Out of 1 895 blood specimens taken in the survey, 138 or 6 7 per cent were positive for malaria Nineteen schools

TABLE 4

Dy County School Bl od Surv y 1929

Date of Surv y W f	Numb f Schools S rv y d	N mb of Specim ns	N mber P sit	P Cent P sit	Comm t
March 18	55	3775	253	6 7	17 Bo m land scho ls w not in session
August 26	55	3642	534	14 7	Sam sch ls as w urv yed in March
August 26	17	480	168	32 3	Schools which wer not in sess n during March rvey
A gust 26	72	4122	702	17 0	All schools



MAP I

R sults of th hool b ood su ey made i Dyer County in Augu t 1929 The h ded po tion of the C ty i the l nd ov flow d by th Mississippi Ri er at the h ight of the fl d in M y 19 9

SCHOOL SURVEYS

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A gust 26	72	4122	702	17 0	All schools

(1) To determine the amount of existing malaria

(2) To outline the malaria problem

(3) To determine the proper procedure of practical control for this particular area

The program of the work was carried out in the following manner

(1) *Blood Smears*—Every individual both white and colored living in the area which extended from the river bed to one and one half miles above the proposed high water level was asked for a blood smear There were 4365 individual smears obtained and sent to the Field Laboratory of the International Health Board at Edenton North Carolina where they were examined for parasites

(2) A malaria census was taken on 1 082 families or 5825 individuals Questions were asked and noted concerning the location owners of land occupant race length of occupancy previous residence number in family screening cases of malaria in the past

(3) *Anopheles Mosquito Investigation*—This included a detailed search for breeding areas of the Anopheles mosquito and a corresponding adult catch in and under houses porches animal sheds privies bridges and hollow trees Along with this information information was collected as to the type of breeding area its permanency and physical characteristics of the water

(4) *Splenic Index*—Examinations were made to determine the splenic index of male children up to 16 years of age and femal children to 12 years of age

(5) *Screening*—All houses were classified as to whether they were screen d or not and the apparent effectiveness of the screening

RESULTS

(1) *Smears*—Blood smears were taken on 4 365 individuals during the months of July to September inclusive 1927 and only four were shown to be positive for tertian malaria The number of smears represents 71 1 per cent of the total individuals on which histories were taken and 54 2 per cent of the total population living within the area at that time

During the summer months of 1928 the examination of blood smears was resumed but only on those individuals giving possibly positive histories of malaria A total of 506 smears were taken showing eight positive seven tertian and one quartan Every one of these positive smears were from persons coming in from outside the area and not from the local inhabitants A record of all sick cases reporting to the emergency hospital showing the number diagno ed as clinical malaria is given herewith

1928	Cases	Malaria
January	33	0
February	39	0
March	46	0
April	53	0
May	98	[illegible]
June	74	1
July	95	0
August	89	1
Total	527	2

The same plan was followed in 1929 as in 1928 that is of examining only individuals who gave a history suggestive of malaria Any accurate follow up and check of the population now was almost impossible because of its transient character Smears were taken on [illegible] individuals showing only four positive tertian slides

(2) *Histories*—A complete malaria history was obtained on 5825 individuals which included 1 082 families There were 803 white families and 279 negro families The histories showed that 262 families had a positive malaria history and they were almost equally divided among the white and the colored residents An interesting fact was noted that over 85 per cent of the people had malaria twenty years before but that less than [illegible] 05 per cent had malaria in the preceding two years

(3) *Splenic Index*—Of the 287 children examined for enlarged pleens only an occasional one had a spleen palpable except on deep inspiration If the premise is accepted that an enlarged pleen is an index to the amount of existing malaria this bit of information coincides with the blood findings

(4) *Mosquito Investigation*—A detailed search was made of anopheline larvae and adults Only third and fourth stage larvae were collected because the lack of suitable space and facilities for care prevented us from rearing the first and second instars No attempts were made to identify the larvae in the field The following types of places were dipped for anopheline mosquito larvae river streams pools ponds wells ditches dumps and borrow pits Two hundred and fifty four separate areas were dipped for anopheline larvae Many of these places were investigated several times in all making 320

showed an incidence of 10 per cent or under Eight had an incidence between 11 and 20 per cent and one an incidence of 41 per cent Those with an incidence above 10 per cent were all close to the Mississippi or Hatchie River The survey indicates that Tipton County has a much less serious malaria problem than counties with a larger area of bottom land

Acknowledgment—The authors wish again to express appreciation of the cooperation of the many persons who have taken part in this study particularly to Mr J A LePrince Mr H A Johnson and other members of the United States Public Health Service to the county health officers in the counties studied and to the staff of the Dyersburg malaria laboratory

SUMMARY

(1) In the study of malaria in West Tennessee in 1929, Dyer County was made the center of activity Observations were made on the rise and fall of flood water the extent of Anopheles breeding places the incidence of Anopheles adults and larvae and the amount of malaria in certain communities

(2) The results are given of school surveys in Lake Dyer and Tipton Counties and of community surveys in Lake and Lauderdale Counties

(3) Dyer County appears to have the most serious malaria problem in Tennessee with a positive blood incidence in the summer school survey of 17 per cent for the entire County and 32 per cent for the schools in the bottom land

(4) The largest numbers of *quadrimaculatus* adults appeared about the middle of June in the bottom land and two weeks later in the hill country

(5) There was a dramatic decrease of adults in the bottom land at the beginning of August following the greatest heat of the summer and a period of drought but in the hill country there was an increase of adults during August

(6) Lake County has a positive school blood incidence of 16 6 per cent for September 1929 as against 13 8 per cent for 1928 Community surveys show about the same amount of malaria as in 1928

(7) Tipton County surveyed for the first time, has a positive school blood incidence of [illegible] 7 per cent

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REPORT OF A MALARIA SURVEY AND CONTROL METHODS ON LAKE MURRAY COLUMBIA, S C *

By L T Coggeshall M D †
Columbia, S C

Within recent years the recognition of malaria incidence and control of malaria about impounded waters has been a study of extreme interest and importance The controllers of the public utilities who are now taking over the control of malaria, on and about their own properties invariably wish to know what is expected from them by public health officials How can they properly conduct a preliminary survey of the existing malaria incidence, the procedure of control what results they can expect and the cost? This paper is being presented with the hope that it will help to answer ome of the queries

Lake Murray is a hydro electric development situated 16 miles west of Columbia S C on the Saluda River The area of the lake bed when full will be 75 square miles and it has a drainage area of 2,396 square miles Its shore line will be approximately 540 miles in length The water is impounded by an earthen dam which will be the largest in the world for hydro-electric developments Its dimensions are one and five eighths miles in length 2,000 feet wide at the base 45 feet wide at the top and its greatest height is 208 feet above the river

When this development became a certainty in January 1927, the South Carolina State Board of Health requested that a survey be made to determine the amount of malaria existing before the water was impounded or clearing of the area had begun This was done through the co operation of the International Health Board South Carolina State Board of Health and the Lexington Water Power Company The field work was supervised by a man from the International Health Board assisted by two medical students and an engineer who were paid by the Power Company all being directed by the State Board of Health

The main objects of the survey were as follows

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*Read before National Malaria Committee (Confer nc on Malaria) me ti [illegible] conj intly with South rn Medical Association Tw nty Third Ann l Me ting Miami Flo ida, November 19 2 1929

†Malariologi t Associated Ga and Electric Company

DISCUSSION (Abstract)

Mr A E Legare Columbia S C—Next summer and the following summers through the cooperation of the Power Company the State Board of Health is going to establish what you might call scholarships taking the outstandin men of the three univers ties boys go ng into sanitary work and ■ e them jobs with a minor salary on malaria control work We shall get one man from the medical college who ntends to go into public health work and in that way three or four men will become interested in malaria control work

I mention this because it may be a sug estion for other states to obtain the same cooperation from power companies

Mr E L Filby Jacksonville Fla—We have near Tallahassee on the Ochlockonee Ri er a small impounded water project known as the Jackson Bluff Hydro elec tric Development The pond created will cover ap proximately 20 square miles and will have 133 miles of shore line.

In 1927 before any work was done upon this project we went over the area within a mile of the proposed shore line taking histories and thin smears from per sons living along this area We followed this later by taking several hundred th ck smears In 19 8 and 29 we repeated this house to house p rson to person can vas takin histor es and smears and now a the project is about completed we hope to ■ ■ you next year a complete p cture of the project from the tart until the work is completed by the Power Company

The most complicated thing in impounded water projects I believe is the labor which is used not only by the Power Company but by one hundred and one little saw mill compan es which contract to take out the t mber These mill outfits are in o way connected with the Power Company except that they have a small contract Also in some cases the timber rights are not owned by the Power Company and private owners work the timber out before selling the overflow land to the Company

I think we should work with the Federal Power Com mission to the effect that any labor u ed on these projects whether for lumbering or dam construction should be kept as much a possible under control rel ative to malar a para tes We can then prevent the importat on of a great number of persons who without treatment would infect our population

In the Ochlockonee case the timber rights were largely owned by other company separate and distinct from the Power Compa y A a n some of the private own ers of the wamp took out their own t mber through pr ate logging operation While it is possible to reg ulate the control of malaria with regard to impounded water s e do *not feel it possible to egulate the control* of malaria in timber operations of which we have many thousands in the State

Mr Leg e—We recogn ed that the small saw mills were a danger so th Power Company instructed all its foremen that upon the ■ ght st indication that any man w s sick he must immediately be sent to the hospital and they took the p ecaution to see that he got to the company hosp tal In that way we stopped any begin ■ g of malaria spread in the neighborhood.

The neighborhood of this project is remarkably free from malaria and of course we are anxious not to have any increase and the Company is exceedingly anxious.

Dr A T McCormack Louisville Ky—Some time ago the South Carolina Legislature passed regulations recommended by the State Board of Health for all impounded waters whether a fish pond or a Power Company lake extending for 500 miles. The power companies have also had experience with law suits in which they have lost m ll ons of dollars consequently they are desirous of having the assistance of any one who will keep malaria out of their ponds

Just 25 miles across the Broad River where they had the dam they had a tremendous amount of litigation. Lawyers and doctors were kept busy giving expert tes timony on both sides and it was a lucrative business for them and disastrous for the power company

I would suggest that the states which have not already done ■ adopt as a law the legislation recommended by the U S Public Health Service for the areas where waters will be impounded.

Dr T H D Griffitts Albany Ga—Georgia was one of the earliest States to adopt comprehensive regu lations on impounded waters and these regulations are effectively applied by the Georgia State Board of Health through commendable cooperation on the part of power companies

Mr M L Clarkson Atla ta Ga—The preliminary work of blood examination is not included in any of the regulations of the State of Geo gia and is in no way connected with the regulations This preliminary investigation is entirely separate and distinct from the State Board of Health regulations.

RECENT OBSERVATIONS ON MALARIA AND ANOPHELES IN THE PHILIPPINES*

By W V King Ph D
Mound La

A recent trip to the Philippines under the auspices of the International Health Division of the Rockefeller Foundation was arranged pri marily for a taxonomic tudy of the local spe cies of Anopheles the classification of which has been much confused The more technical side of the work has not as yet been completed but at this time I should like to bring to your at tention very briefly a few general observations on the occurrence of malaria and its carriers in the Islands

To one accustomed to a close a sociation of malaria with low swamp lands the most striking feature of the situation there is the unusual distribution of the disease On the Island of Luzon to which my observations were limited malaria is pre-eminently a disease of the foot

Read befo e National Malaria Committee (C f r n on Mala ia) m ting conj intly with Southern M dical Associati n, Tw nty Third Annual Meeting Miami, Fl rida, November ■ ■ ■ 9

From the United States B reau of Ent mology

areas were dipped during the summer In rearing mosquitoes, 350 female *Anopheles punctipennis* and 326 male *punctipennis* were hatched, six male *quadrimaculatus* and ten female *quadrimaculatus* were hatched No *crucians* were reared from the area The *Anopheles quadrimaculatus* came from two ponds and two pools respectively

In the adult catching stations, 389 separate places were visited with the following findings *punctipennis* 274 females 49 males *quadrimaculatus* 29 females and three males *crucians* three females making a total of 358 anopheline mosquitoes for the summer

The first *Anopheles quadrimaculatus* was found July 14 and all of the *Anopheles quadrimaculatus* found later were at widely separate intervals throughout the four counties *Crucians* were not found until after August 21 During the month of July it rained 18 days out of the first 21 completely washing out all streams and undoubtedly retarding the normal *Anopheles quadrimaculatus* production

(5) *Screening* —Observations were made upon the screening of houses Families having screened houses numbered 428, or 40 3 per cent of the total number of houses Of the houses screened 420 were white families or 53 6 per cent of the total Eight negro families had their houses screened or 3 per cent of the total

CONCLUSION

All these findings substantiated the belief that for this particular area the malaria incidence was very low but that due to the radical changes in the physical characteristics of the land also that this particular section although relatively free from malaria lies on the border of a heavily infested area it should be very carefully checked and controlled

During the summer of 1928 the construction of the dam was still in progress and the water was not yet impounded The work for this period of time can be briefly summarized by stating that all efforts were made to prevent malaria from coming into the area by infected carriers from outside sources All proven or suspected cases were treated or expelled from the area

The standard treatment was used at the expense of the Power Company

Further studies were made to determine the prevalence of malaria among the native inhabitants, and these findings substantiated by those of the previous summer

Control work was kept up about the construction camps throughout the summer

COST OF THE SURVEY AND CLEARING

The cost of the first summer s work or the initial survey was $2,500 00 For the summer of 1928 it was approximately $1,000 00 This included salaries maintenance, transportation and supplies The cost of clearing the land in compliance with the State Board of Health regulations was approximately $2 500 000 00

CONTROL METHODS

The impounding of the water was not started until September 1 1929 and no mosquito breeding was discovered in the lake as late as October 1 when the work ceased

The control program on this particular lake will be considered along the following lines

(1) Application of oil mixtures and Paris green for larval control

(2) Treating of all malaria cases present

The oiling equipment devised and tested, is a centrifugal trench marine water pump the intake of which is connected to an ordinary steel oil drum This unit is mounted on the bottom of an 18 foot boat which is propelled by an outboard 16 horsepower motor The pump will throw a stream of water one-half inch in diameter 100 feet Into the intake of this pump the oil mixture consisting of kerosene black oil (heavy) and paraffin oil mixed in the following proportions 50 30 20 is introduced and the oil is thoroughly mixed with the water before it is thrown from the pump

This unit will use one part of oil to 120 parts of water which can be varied with a regulatory valve The standard steel drum 52 gallons full of oil will last one-half day mixed in the proper proportions for larvicidal effect The boat in active ■ ■ *will probably oil 68 miles of shore line* per hour

The advantages of this unit is that the oil mixed with water is thrown with sufficient force to penetrate and break up all masses of floatage and vegetation It covers the area to be controlled more effectively with a uniform coating of oil and consumes less time

Paris green is applied by the method devised by LePrince namely the electric generator and the hand blower

Another species *Anopheles maculatus* thought to be a good carrier in other countries occurs in the Philippines and becomes abundant in the mountains and higher foothills Its definite relation to malaria has not as yet been established but it may prove to be of importance in those areas where it predominates

One of the difficulties encountered in attempting to obtain comparative records of the abundance of different species in order to correlate it with malaria incidence is the wild nature of most of the local forms that is they do not ordinarily remain about the houses and stables during the daytime This is especially true of *minimus* whose customary retreat has not as yet been discovered Certain other species are more often found in the building but almost never to the same extent I think as with a species such as *A quadrimaculatus*

Two of the methods used by mosquito catchers in obtaining specimens for dissection and other records are personal exposure out of doors after dark and collection in the vicinity of animal quarters at night On one occasion Mr Mieldazis and I visited a carabao pen shortly before daylight Here by means of flashlights we found freshly engorged females of several species (mostly *minimus*) hanging from the grass blades and fence posts Just at daybreak at the time when our own *quadrimaculatus* would begin to move into shelters these specimens disappeared but we were unable to trace their flight and could find none afterwards in a shed and two nipa houses near by Of many collections made by various workers only a few instances are recorded in which *minimus* was found naturally inside buildings

Another feature of the malaria situation on the Island of Luzon is its seasonal distribution and this also has been accounted for by the habits of *minimus* and the effects of meteorological conditions on its breeding place The west and central portions of the main part of the Island have distinct wet and dry season the heavy annual rainfall occurring mostly in four or five of the midsummer month The torrential rains are said to have the effect of flushing out the small streams so that breeding of *minimus* is generally much reduced during the e months As a result instead of coinciding with or closely following the rainy season the peak of malaria incidence as indicated by the records available occurs normally during the dry season (Tiedeman 1927 Parsons 1928 and J J Mieldazis personal communication) This again is in contrast to conditions in many other parts of the world

The relatively restricted breeding places of *minimus* have made it feasible to undertake control in favorable localities with Paris green dusting Early experiments along this line by Tiedeman (1927) and similar efforts by the Army Medical Corps in the control of malaria at Camp Stotsenburg (Parsons 1928) gave results of considerable promise and the work has now been expanded into a number of control units in various parts of the Islands There are many questions yet to be settled as to the part played by other species but at the present time the control efforts are limited to the treatment of streams The experience so far seems to justify this procedure especially in view of the fact that the operations can cover only a small proportion of the active foci A careful analysis of the results over a short period of years will undoubtedly give evidence of much value for the guidance of further work

I previously mentioned the fact that *Anopheles minimus* breeds at the grassy edges of irrigation canals While traveling through the main rice growing sections of Bulucan and Neuva Ecija Provinces I noticed a number of new irrigation projects under way As this will make possible the cultivation of rice during the dry season it seems likely that the system of canals and ditches will be gradually extended If so it will be of much interest to note the future trend of malaria in areas now comparatively free and a possible increase of the disease as a direct result of agricultural development

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DISCUSSION (*Abstract*)

Dr Jacob Fajardo Manila P I—From time immemorial malaria has been so well known that its usage in diagnosis has become vulgar Instances are known where cases diagnosed as malaria have been found to be otherwise upon pathological or hematological examination Reports of malaria deaths have therefore been exaggerated and the exaggeration is excusable when the extensive practice of not seeking medical attendance is considered Unqualified men often make the diag

hills and rolling lands and, strange to say, is decidedly less important in the typical lowlands

Although generally hilly and mountainous, the Island contains a broad central plain extending north from Manila Bay to Lingayen Gulf, a distance of some 95 miles In the immediate vincinity of Manila are numerous fishponds salt evaporation beds tidal streams and some salt marshes the latter becoming more extensive around the north shore of the Bay Continuous with this low coastal area is a rich alluvial plain extending through parts of the provinces of Bulucan Pampanga Neuva Ecija Tarlac and Pangasinan a considerable part of which is devoted to the growing of rice This area is well populated and is the center of rice culture in the Archipelago

The City of Manila and its suburbs are said to be almost free of malaria and this is also true of a number of villages and rural communities in the rice growing sections in which surveys have been made The low malaria rate in much of the area cannot be attributed to the absence of Anopheles since favorable breeding conditions for a number of species exist throughout as might be expected from the topography and the character of its principal crop In addition to the flooded rice fields there are sloughs and roadside ditches pools and quiet backwaters in the river beds in which larvae are invariably found The fishponds about Manila are especially prolific sources of a salt water breeding species and an extensive fresh water swamp in the eastern part of Pampanga Province is presumably favorable for other species although we made no collections there The most obvious explanation of the relative scarcity of malaria under such conditions is that the common species, fortunately are not effective carriers The residents themselves are evidently sufficiently exposed since screens are not in use at all and the usual dwelling is a loosely constructed nipa house

In contrast to the above are the high malaria rates found in the rolling lands and foothills at the border of this plain and in many other parts of the Island From the epidemiological and other evidence which has been collected this situation points very strongly to the importance as a carrier of a single species out of the 20 or more which occur on the Island This species is *Anopheles minimus* a stream breeder which is found typically in small well shaded streams of clear running water Such streams are abundant throughout the hills It is rarely taken in standing water away from the current or at the edge of the rivers after they widen out in the plain It does, however, breed to some extent in the grassy margins of irrigation canals and in ditches which are led through some of the villages to supply water for household use Certain malarious centers which are not confined to the hills have been attributed to the latter

The probable connection of *minimus* with malaria transmission in the Philippines was first brought out by Walker and Barber (1914), who found it the most susceptible to laboratory infection of five species with which they worked. Barber, Raquel Guzman and Rosa (1915) added epidemiological evidence in support of its being the principal carrier under natural conditions These observations have been confirmed and extended by the International Health Division and the Philippine Health Service whose records show the presence of *minimus* in nearly all malarious places (Manalang 1928) Manalang also gives the results of the dissection of *Anopheles* from one locality, of which 19 *minimus* were positive out of 2 283 dissected as against no positives among 410 specimens of eight other species

Of the numerous species occurring on the Island of Luzon probably less than half become abundant enough to be considered of possible importance All or nearly all of the common forms, however have at one time or another either in the Philippines or elsewhere been proven susceptible in varying degrees to laboratory infection As in other countries the blood feeding habits of susceptible species play an important part in their relation to malaria transmission A species of particular interest in this connection is the salt water form of *Anopheles ludlowi* which is produced about the suburbs of Manila in enormous numbers from the fishponds and salt evaporation beds without giving evidence of maintaining the disease among the residents in the immediate vicinity Curiously enough the species given the same name in Sumatra and Java is considered to be the principal carrier in that region As to the Philippine form it has not been determined whether feeding habits susceptibility or a combination of the two is the deciding factor, and the same statement may be applied to two other closely related and widely distributed species *Anopheles subpictus* and *A vagus*

MALARIA IN PORTO RICO IN ITS RELATION TO THE CULTIVATION OF SUGAR CANE*

By W. C. EARLE
New York, N. Y.

It is commonly believed in Porto Rico that as long as sugar cane is grown there very little can be done to control malaria. Since malaria is one of the more serious health problems and the sugar cane industry one of the principal sources of revenue to the Island as well as one in which large sums of money are invested, a careful study of the relation of the cultivation of sugar cane to the malaria problem is very important. There are three factors to be considered, namely, the Anopheles mosquitoes, the population affected by malaria, and sugar cane, particularly its methods of cultivation.

Three species of Anopheles mosquitoes are found in Porto Rico, but in all probability only one of them, *Anopheles albimanus*, is of any great importance. The adaptation of *A. albimanus* to varied conditions, however, makes the problem as difficult as though there were two or three species which were vectors. It may be found breeding anywhere on the Island from the mountains to the seashore, in fresh or brackish water, stagnant ponds or flowing streams. Epidemics have resulted from breeding under any one of the above conditions, but the usual endemic state is maintained by mosquitoes breeding under a combination of all conditions. This mosquito breeds only occasionally in artificial containers such as barrels and tin cans. Water deposits most favorable for its development are abundant in the coastal region, and since the temperature there averages 76° for the year and never below 60°, breeding takes place all the year round.

Porto Rico is densely populated and there are numerous towns, the largest with a population of 100,000. In the coastal regions these towns are often surrounded by sugar cane plantations. Labor colonies are scattered throughout them and villages may be located on the narrow beach between the arable lands and the ocean. In other regions a scattered rural population is found from the ocean to the mountains.

Malaria is not uniformly distributed throughout the population, but is mainly of significance on the coast. (Mountain: spleen rate 9.2, parasite rate 5.4. Coast: spleen rate between 11 and 56, parasite rate between 16 and 55.) While some variety of sugar cane is found growing in practically all parts of the Island, it is mainly grown on the coastal plain, and it is therefore reasonable that malaria and sugar cane should be associated in the minds of the people and attempts made to prohibit the planting of cane about towns in order to reduce malaria incidence. Sugar cane, however, is extensively grown in certain hilly sections where malaria is not a problem (region of Guajataca Reservoir: spleen rate 6, parasite rate 5.0), and in the coastal region there are other causes than those associated with its cultivation, for malaria is often severe where little or no cane is raised (Humacao Beach village: spleen rate 56, parasite rate 55.) An analysis of the factors will show that cultivation of sugar cane, while usually constituting an important factor in maintaining a fair degree of endemicity, occasionally may tend to alleviate conditions, and that when done with proper care it need not be a factor at all in maintaining a high density of Anopheles mosquitoes. In view of the fact that an attempt is made to grow sugar cane over the greater portion of the coast of Porto Rico, even down to within a very short distance of the ocean, an enormous influence can be exerted on the incidence of malaria by removing this entire cane area as a source of Anopheles mosquitoes.

Conditions vary greatly in different parts of this area both as to rainfall and effectiveness of drainage systems. There is practically no portion that does not receive sufficient rain, along with other factors, to produce conditions favorable for transmission of malaria, so that it is probably more convenient to disregard rainfall and to divide the cane region into:

(1) The lowlands more or less at tide level.

(2) The higher lands with tight soil and poor natural drainage.

(3) Seepage areas.

(4) Irrigated lands.

In their natural state these lowlands are covered by mangrove trees, reeds or grasses, which type of vegetation predominates depends upon the salt content of the water. Extensive inroads have been made into these swamps by

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*The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation.

nosis and since the chill and fever of malaria are well known among the laity and illiterates other diseases with allied manifestations are often branded as malaria

That malaria is rampant in distinct regions and not in all the Philippines is an established fact Investigations and studies of malaria in the Philippines have been done by renowned workers As early as 1909 Nicols associated the disease with streams In 1914 and 1915 Barbour and Walker after experimental infection studies incriminated *Anopheles febrifer* (Banks) and *A minimus* (Theobald) as the transmitters of malaria in the Philippines In 1922 and 1924 representatives of the Rockefeller Foundation after surveys and studies arrived at the conclusion that the two species *A minimus* and *A ludlowii* (Theobald) are the most dangerous carriers of malaria and that practical malaria control would have to take the form of mosquito control using Paris green as the cheapest larvicide From 1924 to the early part of 1926 these representatives continued their demonstrations of malaria control and advocated *Paris green as an effective and cheap larvicide in the* control of malaria

In November 1925 the Malaria Division was created in the Philippine Health Service and 50 per cent of the expenses for the purchase of the necessary equipment supplies and salaries were paid by the Rockefeller Foundation as aid in the campaign In 1927 the Philippine Legislature appropriated 100 000 pesos for malaria control and five units were organized consisting of one physician one field director and several laborers the number depending upon the control areas

In the early part of 1927 after the completion of necessary surveys in Mindanao Dr Ma Chief of the Malaria Division reported that in a survey of 69 malarious places in Luzon and Mindanao *A minimus* a stream breeder was found in 64 or 93 per cent of the places and was the predominant species in 53 or 77 per cent It is believed that if larval collections had been made during the malaria seasons in all those places *A minimus* would probably be found in almost all as the predominant species. There may be a few *locations where A minimus is not the natural vector* but this remains to be shown by further studies or observations In a survey of 25 places in Mindanao and Sulu where malaria was present *A minimus* was always found alone or with the other species while when *A minimus* or its potential breeding places was absent the other species present or abundant there was invariably no malaria Of course the presence of *A minimus* does not necessarily imply the presence of malaria.

Dissections of Anopheles mosquitoes were begun on September 1 1927 and by December 31 1927 there were dissected 2 589 anopheline mosquitoes Of this total 2 283 *A minimus* were dissected and there were found 19 positive stomachs and eight positive salivary glands The rest were mosquitoes belonging to other species None of these were found infected. In 1928 24 148 anopheline mosquitoes were dissected, of which 9 879 were *A minimus* Of these latter 142 had positive stomachs and 104 had positive salivary glands. In 1929 up to July inclusive 20 153 anopheline mosquitoes were dissected Of these 6 283 were *A minimus* with 14 positive stomachs and eight positive salivary glands

Our malaria control consists of anti anopheles operations using Paris green as a larvicide and human control through free distribution of quinine and plasmochin compound in malarious provinces for the extensive treatment of malaria cases and carriers Plasmochin compound has been extensively used at the San Lazaro Hospital of the Philippine Health Service and in the field The experiments have brought out identical conclusions to the effect that plasmochin compound is an effective medicine in the treatment of malaria cases and its effect is particularly more marked on the gametocyte carriers

Dr V G Heiser New York N Y —The paper of Dr King is an additional illustration of the great desirability and in fact necessity for defining the malaria problem *before beginning any* large scale control measures.

In 1921 when General Wood became Governor of the Philippines he looked over the annual deaths and found some 30 000 were charged to malaria He was always keenly interested in the control of preventable diseases His humanitarianism was aroused and he offered to provide a half million dollars and asked me to suggest plans He was greatly disappointed when field studies were proposed as the first step He felt that drainage of swamps more befitted a man of action. *In the light of the knowledge developed* we know now that if the entire sum had been spent on the basis of then existing knowledge that it probably would not have reduced malaria very much

As pointed out in Dr King s paper no malaria originates in the lowlands in the Philippines *it is con*tracted in the foothills Strange to say the great valleys of the Philippines are practically free from malaria With the knowledge now available there is some hope that malaria can be controlled within a reasonable cost though up to this time the cost is *close to 50* cents per capita which is too high for Philippine conditions It is well to recall that there is no frost and the Anopheles can be active the whole twelve months while in the United States they are active only about one half of that time It will be apparent however that the cost of control is much lower than in this Country If malaria control in the Philippines is to be undertaken on a large scale cheaper methods must be found than those wh ch are used at the present time

Army medical officers, after struggling for more than 25 years in attempting to control malaria at Camp Stotsenberg with the resources of a United States Treasury behind them are only now in a position to deal with the situation effectively because they have the knowledge on which to act.

In conclusion I wish to emphasize how necessary it is before we begin malaria control that the problem be definitely defined not only by counties and states, but in the local area The enemy s position must be disclosed before the attack is begun

lation of tile drainage primarily from the agricultural standpoint because the benefits to agriculture are great and the rapid extension of this type of damage over the Island will depend largely on recognition of these benefits To stimulate interest in the more rapid extension of tile drainage in regions where malaria is particularly severe aid has been given to property owners in a few cases But at least half of the cost of drainage is paid by the landowner By means of tile drainage therefore tight soils are made more porous and stagnation of water prevented while in seepage areas the water is collected in the tiles before it reaches the surface of the ground

The last region to be considered is that in which irrigation is necessary It is estimated that 75 inches of water well distributed throughout the year are necessary for a crop of cane On the north coast this amount of rain often falls though it is poorly distributed throughout the year On the south coast only 25 to 30 inches may fall during the year and most of this is in three or four months Since some of the best lands are found in this region extensive irrigation systems have been developed to make possible the raising of sugar cane

It is extremely difficult to determine the actual importance of irrigation water in maintaining the high incidence of malaria which prevails in most of the irrigated regions for there are always other sources of Anopheles mosquitoes as well We do know however that irrigation water in its course from the reservoir to the ocean often breeds Anopheles mosquitoes in large numbers More important still malaria control is always much more difficult in irrigated regions and as a rule it requires a larger staff The water for irrigation comes from a variety of sources government reservoirs in the mountains deep wells, or diversions of water from rivers in their courses through the plains Reservoirs in the mountains give little trouble for they establish a clean margin very quickly they are at a higher altitude with a less favorable temperature and they are not very large so that heavy rains at certain seasons and demands for irrigation at others repeatedly cause great fluctuations in levels

The main government channels which carry the water to the fields are usually kept clean and in good condition. It is after water is delivered to the property owners that the greatest difficulties are encountered All canals are open and only a few are lined with impervious material so that they soon become filled with vegetation Leaky wooden canals are often used to carry the water over low places and small reservoirs for overnight storage become overgrown with vegetation But there are three conditions which are particularly serious in most irrigation systems (1) makeshift headgates which are not watertight are usually used with the result that portions of all canals contain water most of the time even when irrigation is not practised in any one part more often than once every two or three weeks and for only two to three days at a time (2) Small mud dams, used to direct the flow of water into the furrows about the cane plants are often not completely removed after irrigation so that during the rainy months which may follow countless pools of water of varying size are formed along the canals (3) There are many areas in which more water is put on the ground than can be absorbed and only too often the excess water is permitted to pour over waste lands or into swamps where unusually heavy mosquito breeding may result Conditions bad enough in the rainy months are thus made worse and the period of stagnant water is continued longer into the drier months

Irrigation water can be handled quite easily however without breeding large numbers of mosquitoes It is the purpose of irrigation to have the water remain about the plants for not more than two or three days usually one day so that there need not be any trouble in the fields themselves Canals needing water for more than ten days to two weeks at a time must be kept clean or lined with impervious material Usually the number of these canals is small and if necessary Paris green can be applied occasionally The water must be confined to regions actually being irrigated which means above all the installation of watertight gates and the regulation of the flow of water in each canal in accordance with its capacity and needs It is usually possible to arrange the routine of irrigation so that the water can be rotated from one canal to another at weekly or ten day intervals such intervals are too short for complete development of Anopheles mosquitoes Then upon terminating the irrigation of any part or if for any reason the system is not in use all obstruction to drainage must be removed and all canals kept free of water until the next irrigation Last but not least excess irrigation water must be carried

cane planters The ground is banked to get the plants out of water and as the banks may be only 4 feet wide with ditches in between it can readily be seen that not only is a large proportion of land lost in ditching but also the potential breeding area for Anopheles mosquitoes is rendered enormous It is impossible to keep the ditches clean enough to prevent mosquito breeding and the area is often too large compared with the population protected for the practical application of Paris green In those lowlands which collect water from tides floods or heavy rains only a great deal has been done by the use of automatic tide gates both in the reclamation of lands for agricultural purposes and for mosquito control These gates are of little value where water is being constantly poured into lowlands from springs or irrigation systems becau e the difference in tide level is small and the time available for draining the lowland is short These as well as many other areas below tide level must be drained by pumps Pump drainage for mosquito control alone is being done about San Juan the largest city of the Island and arrangements have been made recently on the south coast to obtain assistance from the Irrigation Service for pump drainage of ome of the worst swamps there In most regions this type of drainage is too expensive as an anti mosquito measure alone and control of mosquitoes will have to wait until the area has been reclaimed for agricultural purposes In most cases this means for the planting of sugar cane Pump drainage already installed has tended to alleviate conditions for observations have definitely shown that very little breeding takes place in swamp areas which are effectively drained by pumps and planted with cane Increasing interest in this type of drainage makes one hopeful that in the near future conditions will be greatly improved in many of the worst areas

By far the greater portion of the cane lands is above tide level at least in the most thickly populated regions Most of these are fairly well drained but during periods of prolonged rainy spells water may remain stagnant on the fields for varying lengths of time When cane is germinating and also when it is still quite young it is very sensitive to excess water and everything possible is done to keep water from standing about the plants for more than two or three days When the cane reaches the height of a man or higher the shade that is produced is very unfavorable to extensive *albimanus* breeding In these two respects the campaign against the mosquito is aided Plantations are cut up by numerous roads and ditches and there are always some fields of half grown cane to give trouble in the rainy months During the season for harvesting and preparation for replanting however drainage outlets are abandoned and the cutting of plants removes the shade which was such a great aid up to that point On the north coast especially the soil is rather tight and the rainfall heavy From September through December, between 5 and 20 inches of rain may fall each month though heavy showers may come at any other time of the year as well In most cases these areas can be kept mosquito free by careful attention to drainage outlets, yet there are times when it is impossible to do so and water remains stagnant in every depression in the ground If the area is small Paris green can be applied, but subsoil drainage (which will be discussed later) is a much more effective and permanent method of handling the problem

Seepage areas constitute our worst problem not only because of the facility of anopheline breeding in them but also because of the extensive area involved On the north coast these are usually limited to small outcrops more or less at the base of hills but on the south coast the water seeps out of the ground over large areas, usually within one to two miles of the ocean At one time there were as many as 800 acres of such lands about the town of Salinas, within flight distance of Anopheles mosquitoes In most cases the land is fertile and therefore continuously planted with cane Narrow, shallow ditches are dug so close together that in one acre there may be more than a mile of ditch which will breed *albimanus* very readily until the cane is high enough to produce dense shade It is possible that the cultivation of some of these lands has made conditions more favorable for the breedin of Anopheles mosquitoes

The problem can be handled very effectively by subsoil drainage with tile Interest in this type of drainage has been increasing in the past eight years and results in most cases have justified the original expense Tile drainage costs about $100 an acre, while good land is worth $500 and the crop with average prices may bring $300 an acre This expenditure is soon returned in facility of cultivation aving in ditch making and maintenance and greater area available for planting which was previously lost in ditches We have been interested in the instal

lation of tile drainage primarily from the agricultural standpoint because the benefits to agriculture are great and the rapid extension of this type of damage over the Island will depend largely on recognition of these benefits To stimulate interest in the more rapid extension of tile drainage in regions where malaria is particularly severe aid has been given to property owners in a few cases. But at least half of the cost of drainage is paid by the landowner By means of tile drainage therefore tight soils are made more porous and stagnation of water prevented while in seepage areas the water is collected in the tiles before it reaches the surface of the ground

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directly to adequate drainage channels or to the ocean In practice it usually takes several months to train the labor on a plantation to carry out these measures when a campaign is initiated, but results have generally been good and the expense to the property owner relatively low

The relation between the cultivation of sugar cane and malaria is thus seen to be rather complicated There are many kinds of water deposits and *Anopheles albimanus* is extremely adaptable Soil conditions vary greatly and sugar cane is also very adaptive Some factors in the cultivation of cane are greatly in our favor, such as the pumping of lowlands the necessity of removal of water from fields of young plants the shade produced by maturing plants the great benefit to be derived from tile drainage and the great value of the crop Other factors are less favorable namely the adaptability of certain varieties of cane to conditions of excess water which breed large numbers of mosquitoes the extensive ditching of seepage areas producing conditions very favorable for anopheline breeding inadequate irrigation systems and handling of water, and the location of labor colonies in close proximity to inadequately drained areas It would appear therefore, that there is some justification for the consideration of measures tending to prohibit cultivation of cane about centers of population because of methods of cultivation which favor anopheline breeding There are several factors however which argue strongly against this policy as the only choice Because of the great expense of cultivating wet lands or of irrigating dry lands there is at present no other crop which apparently can be readily substituted for sugar cane in these lands The land would either lie fallow or would be used for pasture, so that conditions in some wet lands might actually become worse The value of the land would drop, revenue to the state would be reduced and because of non productiveness of the land the owner would not be able to spend money in improving drainage for mosquito control alone It has already been shown that it is possible to grow sugar cane in Porto Rico without producing Anopheles mosquitoes Hence rather than legislate against sugar cane which may be an asset to the community the methods used in its cultivation which are harmful should be regulated It is toward this end that new regulations are being studied

While there are many problems in malaria control which seem almost impossible to solve at the present time, I think one should be greatly encouraged by the results of the efforts of the Department of Health in Porto Rico The success of these efforts is due in great measure to its very capable director, Dr Pedro N Ortiz The problem is not so difficult as is the plight of the unfortunate victims of advanced cancer or of tuberculosis, whom no amount of money will save at the present time Innumerable instances in other countries have shown that malaria can be controlled under the most difficult conditions when resources are adequate, and it is encouraging now to see more and more instances of such control in communities of only average wealth In Porto Rico, at least, municipalties and corporations can do a great deal to control malaria, by intelligent handling of water, both by drainage and irrigation and by more careful selection of sites for labor colonies taking particular care to place them as far as possible from breeding areas that are difficult to control

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DISCUSSION (*Abstract*)

Dr W E Deeks New York N Y—I have never been in Porto Rico but the United Fruit Company has cane plantations in Cuba under similar conditions, and our success there in the control of malaria is greater than that in our banana properties in other countries.

Cane plantations are more favorable for Anopheles breeding than banana plantations where there is much more shade

In our cane lands we have rivers and streams which render the general control of Anopheles breeding practically impossible In 1926 we began malaria control in our Cuban plantations where we were at that time hospitalizing about 400 employees annually out of every 1000 in one of the Divisions and about 300 to 1000 in the other Division This year we have hospitalized in one Division 37 per 1000 and 25 per 1000 in the other We have handled our problem a little differently from the way it has been handled in Porto Rico I hope therefore that Dr Earle can visit our plantations in Cuba before he returns to Porto Rico We do not attempt to control all Anopheles breeding throughout our Divisions but we do carry out short range sanitation On the first general sanitary inspection in 1926 it was found that 75 per cent of the breeding foci in our Cuban Divisions were man made such as leaking water taps and railroad water tanks borrow pits poorly constructed ditches hoof prints hog wallows and imperfect drainage everywhere Our attention has been devoted principally to the man made Anopheles breeding places found in the immediate neighborhood of habitations

In regard to irrigation we do not irrigate in Cuba

but we do in some other plantations for example in Jamaica we are using concrete drains and irrigating five days and then cutting off the water for two days.

Now in regard to another point and I would suggest this as important we have just tarted it in two Divisions We are centralizing our population We are establishing town centers and where originally we had four settlements to take care of from a sanitary stand point we now have one We do not attempt sanitation over 300 or 400 yards from the habitations An other thing we do which is working out satisfactorily is to make every farm superintendent overseer and fore man in our Agricultural Department and the railroad right of way responsible for the control of mosquito breeding around his immediate vicinity and we are insisting on co operation everywhere as the rule in controlling mosquitoes No man is allowed to have leaking water taps and open reservoirs around the habitations which be in his charge of The railroads are compelled to take care of the sanitation of their right of way within half a mile of any habitation They are responsible for its are and up keep and are not allowed to dig and leave open borrow pits to breed mosquitoes. Such people are not allowed to remain in camp longer than a few days when they are compelled to go to the hospital. In this way we have been able to control malaria in Cuba not by widespread sanitation but by short radius methods within one quarter of a mile

We have not as yet adopted screening except for the selective population of the more intelligent class who are susceptible to malaria and who can be depended upon to keep the screening intact

It is through eradication of those man made breeding places in the immediate vicinity of habitations that we have effected the greatest control of the problem

Dr Mark F Boyd Jackson Miss—The conditions under which Dr Deeks is conducting his program are radically different from those in Porto Rico Dr Deeks is dealing with a corporation operating under publicity properties that he owns or controls Dr Earle is obliged to effect co ordination over a wide variety of properties and dealing with individual land owners so that the program that Dr Deeks is developing is effective under the conditions that he has but I do not feel that the two conditions that have been described are altogether comparable

Dr Herbert C Clark Panama—My interest was long ago centered on eradication of malaria my hope now is merely to suppress malaria from an economic stand point Eradication of malaria belongs to another generation I am afraid.

In the six years that I have been watching labor camps I have noticed that the contractors employ men that they know are physically unfit to perform the duties of a laborer in order to give them hospitalization In the last two or three years we have selected the laborers better The physical selection of labor is of great importance and the more medical attention you can carry to the camps the better

I have examined men actually at work (not out of a box car) and compared them with the stay at homes who were in the camp when labor hours were on The field men range about 15 per cent positive the stay at home range anywhere from 40 to 100 per cent positive

The Madden dam up the Chagres River is connected with a road building project of about 60 miles which will take five or six years to complete That is calling for a large unit which is not connected with Canal Zone work and they are put into the Chagres River Valley camps. These camps have their men leaving Saturday and returning Monday to ordinary rural villages on the banks of the river The banks have been cleared in large areas and there is sanitation for a short range around that area The men have been put in large screen barracks and the food is supplied and prepared. They get a studied ration and protection during the week except during the week ends That labor force is averaging 6 to 10 per cent positives It is one of the best controls I have seen of a large labor force camp in compact formation

It is a good plan to see that the men get a substantial ration three times a day Labor left to supply its own food is not going to do that

Dr Dalferes P Curry Panama Canal Zone—Dr Clark did not see one thing that I saw in the camps on the Chagres River He did not see these laborers when they were recruited 50 per cent of them could not push a loaded wheelbarrow We did not take many into the hospital but we did send liquid quinine to them to be taken by those who desired it The majority of them received almost no treatment but they were put into the screened barracks and received excellent food The most noticeable thing was the immediate evidence of improvement in their physical condition They had lacked food The American ration is different from the native ration Under good food the men have improved until now it is the best looking crowd of native labor that can be found in the tropics. The use of screened barracks in temporary jungle labor camps has been to me a striking thing and it is one thing I had to fight for when we planned this work The first idea was to combat malaria with drainage and oil but I do not think that extensive drainage would have been justifiable for a labor project that was to last only one year To have done drainage work on anything like the scale that seemed indicated would have meant to spend as much on drainage as we would have to spend on the actual labor of grading the roads so we compromised on screened barracks of large size We had thought of portable camps but they were not practicable We gave our plan to the engineers and sold the idea to them Every board every sawed timber sheet of roofing and roll of screen that went into the first of these buildings was carried afoot over we jungle trails I am glad to have Dr Clark's endorsement for I think that is one thing that saved the labor situation at Madden Dam and made possible road construction at a justified cost for sanitation

MALARIA CONTROL IN HAITI*

By S S Cook M D †
Port au Prince Haiti

Haiti with her 10 000 square miles of terri tory and two million p ople has passed through varied stages of exploiting and being exploited

From time to time a native more intelligent and more ambitious than his countrymen has proclaimed himself emperor king or president as the case might be and for a brief period has flourished and has indeed at times brought many improvements to his country However such periods of domination were foredoomed to fail ure and endured only by virtue of the frenzied applause of an ignorant populace

It would serve no useful purpose to detail at this time Haiti s many vicissitudes at her own hands and the hands of supposedly friendly foreign powers Suffice it to say that conditions had reached the stage in 1915 when it became necessary for the preservation of the integrity of the country that some friendly power come to her rescue After diplomatic exchanges and the usual preliminaries a treaty was concluded with the United States in 1916 by virtue of which the United States took over the collection of customs and supervisory charge of certain other activities

In 1919 a National Public Health Service was created by law to direct Haiti s sanitary and medical problems This Service under the ad ministration of naval medical officers has stead ily grown until there are at present ten public health districts with a well equipped hospital in each The Public Health Service now com prises five principal divisions namely hospitals and rural clinics quarantine and sanitation medical education finance, and transportation and supplies It was seen early in 1923 that to reach the masses it would be necessary to take treatment to them Therefore rural clinics as funds became available, were established in con venient locations throughout the island from Ouanaminthe in the North to Anse a Pitre in the South

To understand the situation in Haiti it is nec essary to realize that there is no middle class There are the reasonably well educated city people on the one hand and the approximately 80 per cent of the population made up of illit erate country people on the other To reach this 80 per cent who, through fear and timidity seldom came to town it was essential that they be treated in their own neighborhoods These facts have been repeatedly stressed by Butler Payne, Hoffman and Peterson Through rural clinics an increasing number has been reached each year until during the fiscal year of 1928 1929 almost one and one half million treatments were given Malaria yaws and intestinal para sites are the principal causes of morbidity and in the aggregate produce infinitely more suffer ing and non productiveness than all the other diseases combined

Records of the incidence of malaria in Haiti from her discovery in 1492 to 1915 are some what sketchy but nevertheless in sufficient detail to indicate its high prevalence throughout this period Several of the physicians of the French Colonial days left clinical descriptions of what is believed to have been malaria and they refer to epidemics of fever that affected many of the colonists Dr Leon Audain who began prac tice in Port au Prince in 1891, was deeply in terested in tropical medicine and reported that in 1909 1910 malaria was epidemic in Port au Prince and in 1911 1912 published the results of his laboratory examinations in 30 positive cases representing the first scientific laboratory work done in Haiti Of the 30 cases, 76 per cent were malignant tertian, and this figure does not differ greatly from present-day findings Data are available from several sources to indi cate the extent and severity of the disease from the beginning of the American Occupation in 1915 to September, 1929

Personnel of the United States Marine Corps were distributed throughout the Central North ern and Western sections of the Island from 1915 to 1923 and naval medical officers on duty with them have published descriptions of ma laria prevalence among the Marines and also in the native settlements near by Abstracts from their published reports are cited

Dr Allen[1] states

> Malaria was responsible for 16 986 sick days in the First Brigade in 1921 The average strength was 2 115 the number of admissions was 2,056 In the first six months of 1922 the number of admissions was 425 Five deaths occurred in 1921 and three so far this year

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Read before National Malaria Committee (Co fer ence on Malaria) meeting conjointly with South rn Medical Association Twenty Thi d A nual Meeting Miami Florida November 19 2 19 9

From the National Public Health Service of H iti

†Lieutenant Commander Medical Corps Unit d States Navy

From the beginning of the Occupation until recently (1923) malaria has caused the greatest number of sick days and deaths in the Marine Brigade. The Marines in order to perform their mission in Haiti were compelled to patrol the entire area of the Republic. This necessitated forced marches for days over mountain ranges, long periods of garrisoning isolated hotbeds of brigandage or revolution, and in general subjected them to the hardships of a guerilla warfare conducted in a tropical country. The last actual fighting occurred in 1921. Since then Marines have been garrisoned in more or less permanent posts. On the establishment of these more or less permanent posts the naval medical officers on duty with the troops busied themselves with general sanitary measures such as drainage, cutting down underbrush near camp, filling in or oiling pools of water, etc. Despite these ordinary means and the compulsory use of the mosquito bar at night malaria was rampant, reaching its high point in August and November of 1920 and in February and *June of 1921. In some detachments the admission rate* was over 4,000 per 1,000.

Dr Storch[3] states:

Every native upon questioning has admitted at least one attack a year, the average number of attacks however is three or four, while one man stated that he had twelve attacks during the year. In Port au Prince an examination of 800 slides shows an average of 42 per cent infection. Pont Beudet, 12 miles northeast of Port au Prince showed 60 per cent infected."

In 1925 outlying posts were abandoned and all Marines garrisoned in Port au Prince and Cape Haitian. Reports of the Brigade Surgeon of the incidence of malaria since then show for the fiscal year 1926 (July 1, 1925 to June 30, 1926) an annual admission rate per 1000 of 124.3, for the same period of 1927, 53.4, for 1928, 137.9 and for 1929, 90.0.

Statistics furnished by the Medical Director Garde d'Haiti are of interest. The organization *in effect a national army has a personnel* of about 2,000 composed of native troops and officers with 120 Marine officers. The Garde personnel is distributed throughout the island in *every city, town and country village*. Except that they have better food, clothing and medical attention these men may be considered to represent a fair sample of the population. They do *not live in screened barracks*, use no mosquito nets and by the nature of their duties are exposed to malaria to as great a degree as the civilian population. In Table I the annual ad*mission rate per 1,000 is shown*.

The largest number of laborers and school children to be examined by a single group of laboratory specialists was that done at the emigration bureau of the United Fruit Company, Port de Paix, November 30, 1927 to January 30, 1928.

TABLE I

Malaria Admissions, Garde d'Haiti, 1924 to 1929

Annual Rate per 1000

	1924	1925	1926	1927	1928	1929
January	242.2	165.6	120.0	163.0	140.4	121.2
February	166.8	171.6	134.4	150.0	109.2	84.0
March	122.4	80.4	120.0	4.4	128.4	93.6
April	114.0	8.0	107.6	55.[illegible]	109.2	60.0
May	100.8	90.0	55.2	92.4	56.4	92.4
June	204.0	1[illegible]0.8	135.6	68.4	94.8	106.8
July	363.6	138.0	117.6	108.0	188.4	87.8
August	273.6	268.8	94.8	94.8	207.6	141.6
September	235.2	224.4	178.8	195.6	122.4	106.8
October	268.8	2[illegible]7.2	247.2	134.4	218.4	
November	2[illegible]9.6	229.2	235.2	217	85.2	
December	229.2	181.2	272.4	129.6	122.4	

A total of 11,000 laborers were examined by thick film and 23.5 per cent found positive. Of the 2,007 children examined 50.52 per cent were positive.[4]

Other workers have reported a high proportion of malignant tertian infections in Haiti and this survey confirms this observation, 86.3 per cent of the laborers and 86.19 per cent of the children presenting this type of infection.

Within the past year 3,176 school children were examined in Port au Prince with a finding of 8.2 per cent positive.

In November 1928 an epidemic was reported at St Louis du Sud, a town of 700 people on the South coast. Investigation revealed 65 people of all ages ill in their homes. Blood smears were positive for malignant tertian malaria in 63 of them. In the same month smears made on 25 children in the market place of this town were 100 per cent positive.

In March 1929 some of the inhabitants of Vieux Bourg, a town of about 200 people also on the South coast, reported much fever in the *town. Forty three persons with fever were seen* and blood smears made on these were 39 per cent positive for malaria.

Anopheles albimanus, the malaria vector in Haiti, breeds anywhere and everywhere in almost any kind of water. This statement originally made by Peterson and Hoffman has been confirmed by other workers. While there may be a preference for certain types of water and a particular kind of food from a control point of view no collection of water can be disregarded. Clean open water with algae or other vegetation such as is found in rice fields appears to be very favorable breeding sites. Running water such as irrigation ditches is less

desirable, although breeding does occur in such locations.

Household and yard containers that are preferred by *Aedes aegypti* do not particularly attract *albimanus*. They have, however, been found in such places. In towns where shallow wells are used, many of them become overgrown with algae and furnish many anophelines.

In a swamp near Petit Goave *albimanus* larvae were found in the grass along a drainage canal near the sea. The salinity of this water was 0.3 per cent sodium chlorid.

Breeding in a river near Jeremie is of interest, as it nearly parallels conditions at Quantico, Virginia, Broad River, South Carolina, and a few other places in the United States. This river, which is about 150 yards wide, has a heavy growth of chara and potomogeton along the west bank and extending about 60 feet towards the center of the stream. In this dense mat of vegetation in water from two to six feet in depth *albimanus* was found in tremendous numbers. The water is clear and fresh and has a perceptible current.

Quadrimaculatus bred heavily in a strikingly similar situation in Quantico, Virginia.

A. grabhamii is the only other anopheline thus far discovered in Haiti.

With conditions as described in the preceding sections, the problem of malaria control has been and still is an exceedingly grave one.

The policy of first attacking the centers of population was adopted early in the history of the Public Health Service and has been steadfastly adhered to.

As a result we can point with pardonable pride to the satisfactory degree of control in Port au Prince, Cape Haitian, St. Marc, Gonaives and Jeremie.

Efforts at control have been along three main lines:

(1) Drainage and filling.

(2) Use of larvicides.

(3) Quininization.

Port au Prince, being the largest city in the island and also the capital, the earliest efforts were directed towards ridding this city of malaria. The water front for a distance of almost two miles, originally a swamp with many rice fields and prolific anopheline breeding, has been filled in and drained. Other low lying sections in the city have also been drained. Although it can not be said that there is no malaria in Port au Prince, it has ceased to be a problem and most residents no longer find it necessary to screen their homes nor use mosquito nets.

In Cape Haitian extensive drainage and filling since 1915 has materially decreased the malaria incidence.

In St. Marc, a town of about 12,000, several sluggish streams that formerly ran in crooked, winding channels through the city have been straightened, filled along the sides, and in places cemented. All the principal streets in the town have been graded and curbs and gutters installed. As a result St. Marc [redacted] practically free from malaria.

Gonaives, a town of about 15,000, is located 110 miles northwest of Port au Prince on the edge of a desert. North and east of the town there are a number of springs and swamps that formerly furnished vectors for th town. These have been drained and connected throu h staked canals to a large canal that drains them into the bay south of the town. Undrainable places have been filled with treet sweepings. This system of drainage canals has solved the situation there and requires only maintenance to keep the town practically free from malaria.

Jeremie and Jacmel, one on the southern and the other on the northern side of the southern peninsula, present common problems. They are both built on hillsides overlooking the sea with adequate slope for drainage. Emptying into the sea near each is a river that affords abundant breeding grounds for anophelines. In the city limits of each the construction of rock or cement lined curbs and gutters has practically obliterated favorable anopheline breeding sites. Breeding in the rivers is being controlled by Paris green dusting.

Petit Goave, a town of perhaps 8,000, located 40 miles southwest of Port au Prince, is built on low land with mountains several miles south of it. From these ranges many streams flow down into the flat country, becoming sluggish as level country [redacted] reached and finally ending in large swamps. With such conditions in the city the problem may be easily visualized. At present all of them have been partially or completely ditched, low places filled and staked canals installed connecting them with the sea.

Cayes, a city of about 20,000 on the southern side of the southern peninsula, is located on a coastal plain that extends twelve or more miles back to the mountains. Ravine du Sud west

of the city is ordinarily a small swiftly moving stream fed by springs in the mountains Periodically heavy rains cause the stream to overflow its banks and inundate the town At such times all the streets of the town are covered with water to a depth of two or more feet Several large drainage canals help to carry off flood waters and there are many low lying areas that will be handled as additional funds become available Within the past year over 25 miles of ditches have been dug in swamp areas within anopheline flight range of the city In one section known locally as Habitation O Shiell a drainage system primarily installed for mosquito control has reclaimed more than 1 000 acres of valuable farm land at a cost of $2 00 per acre Work is about to commence on a dike road north of the city which will divert the flood waters and prevent inundation of the city Filling of undrainable areas has been accomplished by use of street sweepings and sand

Many property owners are averse to making improvements to their places but will allow the Public Health Service to do the work for them at the owner s expense This system has permitted obliteration of many breeding places within the city It might be mentioned that this characteristic has been observed throughout Haiti

In addition to major drainage projects such as those described a great deal has been accomplished in the smaller towns

In some instances drainage in small communities has produced strikingly beneficial results Unfortunately lack of local interest has permitted a lapse in some places The policy at present is to install drainage systems only in places where there is reasonable expectation of permanent maintenance

There is no single plan of drainage applicable to the whole island

In Port au Prince for example 1/3 section 32 inch concrete tile has been used for open drains and for subsurface drainage 4 inch and 6 inch round tile

In Petit Goave V shaped earth ditches are used in certain sections and staked canals in others These stakes are 3 to 4 feet long and about 2 inches in diameter Placed close together along the banks they support the bank and last several years

They are used in many places and while not so satisfactory as cement are much less expensive and serve the purpose very well Permanent concrete canals are installed whenever money is available All districts have their own tile making machines for the 4 inch and 6 inch sizes The low cost of labor makes the use of dynamite and machine ditching out of the question

Laborers receive 20 to 30 cents per day for a nine hour day and a plentiful supply is always available

For filling near the sea beach sand is often transported in grass baskets on bourriques These diminutive jackasses driven by a woman with a big stick are aptly said to carry the burden of Haiti on their backs They are reputed to be able to carry a load equal to their weight

Laden with sand lime rocks dyewood 6 squealing pigs or 10 bleating goats they steer a straight course in the center of the road from which no amount of honking yelling or cursing will swerve them

Until recently oil was the principal larvicide used Crude oil purchased in the United States in 50 gallon drums costs about 20 cents per gallon delivered in Port au Prince In other words a gallon of oil and a day s labor cost about the same

Waste oil in limited quantities is obtained in the larger cities at very small cost This diluted with kerosene has been used with good results Oil is applied by means of knapsack sprayers The occurrence of daily rains during a portion of the year greatly increases the cost of oiling and also demands the use of a highly toxic oil As new breeding areas are brought under control the cost of oil naturally increases and the cost of this single item makes serious inroads on our budget

Sporadic attempts have been made to substitute Paris green but lack of familiarity with its use and limitations has prevented its general adoption Experience with it during the past year has been very satisfactory and its use is being gradually extended over the island Airplane dusting has been done in two areas with splendid results in each instance One pound of Paris green per acre in a 33 per cent mixture with slaked lime was used

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laria incidence in the larger centers of population

(3) *Anopheles albimanus* the malaria vector for Haiti is found throughout the island at elevations below 3 000 feet

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DISCUSSION (*Abstract*)

Dr Mark F Boyd Jackson Miss—I should judge that from an epidemiological standpoint the picture that Dr Cook has sketched does not differ radically from that which might be presented by any of the West Indies Any difference that one might note is due to the peculiar political and social conditions that prevail in Haiti

The problem that faces Dr Cook and the American administration is undoubtedly complicated by the absence of medical practitioners over a great bulk of the country so in considering the malaria problem they have not only to consider curative but preventive medicine as well

I anticipate that the species mentioned as occurring in Haiti will later be increased by one or two species *Vestitipennis* has been found Porto Rico and Jamaica and will probably be found in this island as well *Anopheles crucians* may later be found

Dr Henry E Meleney Nashville Tenn—One of the most interesting things which Dr Cook has reported is the use of Paris green as a general larvicide If his observations are confirmed in this Country the use of Paris green may prove to be a very important method of general mosquito control

Dr Cook (closing)—I have not reported the experiments with Paris green because we are still running some and planning to test its toxicity for animals

The native of Haiti will drink any kind of water no matter how hot or how foul Of course we have said that Paris green does not make drinking water poisonous But in our Country we have not the trouble we have in Haiti Americans do not drink just any kind of water

We have observed that in a number of places where the cattle and horses drink the water they are not affected

MALARIA IN HAITI*

By FREDERICK L HOFFMAN LL D †
Wellesley Hill Mass

The malaria problem in Haiti after a number of years of American administration is in a fair way of being solved if we define the word solution as a reasonable compromise between the ideally desirable and the practically possible Dealing with a vast and primitive population there are insuperable difficulties which can be solved only after many years The problem is visualized in the statement that in the calendar year 1927 rural clinics in Haiti under the direction of the American Government dealt with 31 483 cases of malaria from the most mild to the most malignant types of the disease In the public health hospitals under the American administration the number of out patients treated for malaria was 3 613 and the number of in patients 331 The in patients had 3 944 days of treatment while the out patients had 5 370 days of consultations and treatment Obviously the latter received practically but superficial attention or represented comparatively mild types of the infection

It has been my privilege to visit some of the rural clinics in the vicinity of Port au Prince and I can only express myself as being most favorably impressed with the attention which is being given to individual patients on the part of an inadequate medical staff But to me nothing is more encouraging than to observe the large number of patients who throng the clinics with perfect faith in the skill of the attending American and native physicians The American Government in Haiti is utilizing native personnel to the fullest extent and the Haitian native medical profession is second to none in its adaptability to the needs of local requirements The same applies to native nurses whom I found admirably adapted to native needs

The number of deaths from malaria in Public Health hospitals in Haiti for the year 1927 was surprisingly low There were 25 deaths from malaria and 14 from malariae cachexia Most of these deaths occurred above the age of twenty In the whole Republic during 1927, the num

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*Read before National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Twenty Third Annual Meeting Miami Florida, November 19 22 1929

†Consulting Statistician Prudential Insurance Company of America

Recent experiments with a mixture of Paris green and moist sand indicate its practicability as a general larvicide. Following the technic of Griffitts[5] one teaspoonful of Paris green was mixed with 99 teaspoonfuls of moist sand. After thorough mixing it is applied by hand. This amount when applied to 340 square feet of breeding surface gave uniformly satisfactory killing of all larvae within three hours or less. After convincing ourselves of its efficacy against anophelines and non-anophelines in several different types of breeding area we made a number of attempts to reduce the dosage. In this effort we not only reduced the amount per acre by wider distribution but also tried higher dilutions, namely 1 to 150 and 1 to 200. In a few instances ½ pound and even 1/3 pound gave 80 to 90 per cent mortality. A higher dilution than 1 to 100 did not prove satisfactory.

As a temporary control measure quinine can and does accomplish much. In many rural communities it or some other drug will likely remain for many years the only agent at our disposal.

If all the natives who harbored malaria parasites could be induced to take adequate doses of the drug over long periods of time there is little doubt as to the end result. This, however, is something for the educational work of the future. The longest period of treatment that can be expected at present is for the duration of fever. So long as the Haitian feels that he has fever he will probably continue treatment. There is no way, of course, to measure the benefit to a given community of such a varied procedure.

In each of the ten hospitals of the Public Health Service a thick smear is taken on each patient admitted. Those found positive are given quinine throughout their stay in the hospital.

In the 147 rural clinics thousands of treatments are given annually. It is not possible to do any laboratory work on these cases, as one physician may treat 500 to 1,000 people in a single day. Reliance for a diagnosis must therefore be placed on symptoms and a very brief history. All patients complaining of fever are given quinine unless there is some other obvious reason for the fever. The dosage depends on the individual prescribing treatment, although it may be said to average as much as 10 grains three times daily for a week. While such amounts surely do not render the man parasite free, he is given sufficient symptomatic relief to permit him to work and thus obtain food for himself and family. The free distribution of quinine through the rural clinics and hospitals is supplemented by its sale at cost to all who apply.

The percentage of illiteracy throughout the island is so high that publicity in the form of pamphlets or other printed matter is well nigh impossible. News spreads through the rural sections almost entirely by word of mouth and attempts to disseminate information through the leading men in the community has proven to be of little value. In recent years all the larger towns have been equipped with radio, over which musical programs and news of the Governmental departments are broadcasted. Through this medium public health information is disseminated. In the cities information is published in the newspapers.

The Agricultural Department has farm schools in many of the rural communities and the teachers from them are brought to Port au Prince every summer for a six weeks course at the Central Agricultural School. Included in this course are lectures by the Public Health Service on a number of subjects including malaria. They will no doubt carry some knowledge of malaria back to their school children.

Children in the public and private schools of Port au Prince are given weekly talks on hygiene and other subjects, particularly including malaria. As funds and properly trained personnel become available this work will be extended to cover all of Haiti.

In examining school children blood smears are taken and those found positive are advised to go to the Health Center for treatment.

SUMMARY AND CONCLUSIONS

(1) Malaria, yaws and intestinal parasites are principal causes of morbidity in Haiti.

(2) Improved sanitary conditions since 1916 are responsible for a marked diminution in ma

the winter and the drainage canal dug there proved effective in preventing this annoying occurrence Ma laria is rarely seen in Cape Haitian now and the few patients treated at the Justinien Hospital contract the disease outside the town The filling in of low marshy ground about Cape Haitian was continued during the year Twelve thousand seven hundred and forty two (12 742) cart and truck load of rubbish from street boxes were dumped here The oiling and closing of abandoned wells was continued The system of house to house inspection was continued

For the sanitary district of Aux Cayes it is said

The filling of the Renaud River draining of swamps and oiling have been continued throughout the year Most of the water holes produced by the construction of curbs and gutters and the concrete drain were filled up Eleven private properties in the low sections of the town were filled with fatra sea sand and gravel and part or total expenses were reimbursed to the Service for work done

A brief account of the district of Jeremie states

In the town of Jeremie no larvae of the anopheles mosquito were found The larvae of others were found in 536 places Oil sprays are used to destroy these breeding places

The town of Dame Marie is heavily infested with malaria but it is hoped that this condition will be ameliorated soon as the Public Health Service has turned over to the public works sufficient money to drain a number of swampy areas

The problem is rather serious in the sanitary district of Petit Goave as illustrated by the following statement

On account of the topography of much of the land near Petit Goave the control of the mosquito breeding continues to be a major problem and for complete eradication of this pest the expenditure of much money will be necessary It would seem that if some of the high mountains could be torn down and dumped into the swamps that the leveling up would help in more than one way Unfortunately the level of the swamps does not permit of good drainage into the sea In fact in some places the marshes appear to be below the sea level

An extended account is rendered for the district of Saint Marc from which I quote in part as follows

This will continue to be one of the most important problems in sanitation The numerous cane fields rice fields and banana gardens within the city limits offer obstacles which are difficult to overcome In order to eradicate Anopheles breeding it is necessary to keep constant supervision over the numerous irrigation canals to keep them open repaired and free from vegetation The only solution to the problems would be if possible to discontinue all farming within the city limits and cement all irrigation canals Various dirt canals have been opened during the year and this has made a big improvement in certain parts of the town The three inspectors are constantly going over the town looking for mosquito breeding places and eliminating them also spraying oil on all stagnant water found instructing the owners of properties as to the proper methods to be taken to eliminate the mosquito breeding places that are found We have been successful in convincing some of the property owners that not only is the sanitary condition of the town improved but that over a period of years it is more economical to have cement canals than dirt canals for irrigation purposes They have co operated with the Service d Hygiene and have built the cement canals thereby eliminating several bad mosquito breeding places

It has occurred to me that the foregoing ex tracts from the last annual report of Commander Melhorn would serve a better purpose than ob servations of my own based on a rather hurried inspection during the early part of the present year The American Public Health Service of Haiti is leaving nothing undone to bring the malaria problem to at least as high a degree of control as in the malaria sections of this Coun try Americans have reason to be proud of what the American Government has done in the Haitian Republic in every possible direction min istering to the higher needs of a primitive popu lation but in no direction has more effective service been rendered than in the promotion and development of the native medical organization which is rapidly filling most of the important posts connected with the sanitary administration of the Island The native Haitian has shown a remarkable degree of adaptability is eager to learn and anxious to apply whatever may be learned from the experiences of the greater Re public which for the time being administers all the essential governmental functions in the Haitian Republic To the student of the ma laria problem Haiti at the present time is a great laboratory and many questions are being dealt with in the light of the most advanced scientific research with the hope that in a few years the malaria problem in Haiti will be under effective control and that the menacing condi tion found to exist at the time of our occupancy will be a thing of the past

ber of deaths from malaria was 1,096 Of this number 557 were deaths of males and 539 deaths of females There was also one death from hemoglobinuric fever and one death from malaria cachexia Unfortunately as yet the registration of deaths for the entire Republic is incomplete so it would not be advisable to calculate death rates in proportion to the estimated population As observed in the annual report of Commander K C Melhorn, Director General of the Public Health Service of Haiti,

> The vital statistics in Haiti continue to show many discrepancies and will continue so until the present archaic laws governing registration of births deaths and marriages are annulled and replaced by legislation whereby such registrations can be made free of any and all tax to the entire population Now only indigent persons register free of tax

As long as these conditions prevail, complete registration of deaths is of course, practically hopeless The problem is to appeal to an estimated population of about 2 000 000 scattered over an immense territory much of which as yet is difficult of access presenting possibly one of the most perplexing problems in registration anywhere in the Western world But progress is being made thanks to the progressive and always energetic health administration of the American Government which is a credit alike to the United States and to the heartily cooperating native population

The Division of Laboratories of the Public Health Service is divided into three units under the supervision of a director a medical officer of the United States Navy with central offices at Port au Prince With reference to malaria it is said

> In the department of malaria the thick film method is used exclusively with most gratifying results We find this technic not only to be less laborious but the results are far more accurate than those obtained from thin smears Our routine is to examine every patient for malaria who is admitted to the hospital and to re examine the following day all those who are negative on the first test The technic employed is to take a large drop of blood from the ear on one end of a clean slide With the corner of another slide spread this out over an area the size of a dime and allow to dry thoroughly about thirty minutes in the air Twenty five slides are now numbered and bound together with elastic interposing a piece of card board between each The ends of the slides having the blood are immersed in a rectangular staining dish containing dilute 1 15 Azur II Eosin Grubler for 30 minutes At the end of this time they are removed from the stain immersed in distilled water to remove the excess stain and allowed to dry in the air without blotting"

The foregoing is sufficient evidence that the scientific work in connection with malaria cases is fully equivalent to what is being done on the mainland of the United States I may add that a number of Haitian technicians are employed in connection with this work and are rendering excellent service The number of blood smears examined for malaria in 1927 was 5,733

On the subject of mosquito control the report for 1927 28 contains in part the following interesting observation

> Much has been accomplished during the past year in filling and draining the swampy areas in the south west portion of the city along the shore line Work in this section has been continuous for several years in an attempt to drain and fill swamps within the anopheline flight distance of the city
>
> The swampy area back of the electric light plant formerly a network of poorly graded open ditches, has been drained with subsurface tile and filled with refuse A deep ditch was dug from the upper part of the property to the sea graded with rocks on which two rows of six inch tile were laid and covered with gravel and refuse Many laterals of four inch tile laid in the same manner and covered with gravel and refuse has rendered the swamp entirely dry This property has an area of about two acres and is adjacent to the boys reform school which has an average of 300 inmates Malaria rate amongst these boys has always been very high 135 7 per thou and for last year probably being comparatively low
>
> Fourteen thousand six hundred sixty four gallons of crude oil and one thousand nine hundred seventy six gallons of kerosene were used during the year in this district in mosquito control work The kerosene is used to dilute to spray consistency the old crank case oil obtained from various garages without cost Some experimental work in use of Paris green as a larvicide was done It was determined that for our work in and near the city the use of oil has the advantage When mosquito control can be extended to the swamps and rice paddies in the rural sections Paris green will undoubtedly be the accepted larvicide Control of the breeding of domestic mosquitoes is a very discouraging problem Water is stored in some form of container on practically every property Of the notices sent out last year in Port au Prince 595 or 31.8 per cent were offenders against the mosquito breeding regulation

During the year under review the percentage of property inspected showing larvae ranged from 1 1 per cent in July to 2 7 per cent in October To the foregoing I add a few observations for particular districts as illustrating the local work that is being done

> There was no recurrence of the mosquito breeding in the salt marshes south of Cape Haitian such as occurred last summer The tide gates put in during

We have passed through a dark period of impounded water control and at times our problems seemed almost hopeless. We are now emerging from this period and feel very optimistic. Although rural drainage is progressing in several counties on a large scale, we shall welcome the day when drainage by county officials will keep step with control of impounded waters by corporations.

MALARIA CONTROL IN MISSISSIPPI DURING 1929*

By MARK F BOYD, M D †
Jackson, Miss

The activities of the State Board of Health during the current year have been promoted along the following lines

(A) *Relation of Program to County Health Department.*—The whole time county health departments created through the initiative of and furthered by the State Board of Health are devised to achieve the intimate contact with the citizenship of the State which is essential to the promotion of public health. Any malaria control activities whatsoever promoted by the central State organization should be done by, through and with the whole time health department. Consequently, in order to be practical, any program of malaria control must be one the execution of which can be effected with the personnel and resources ordinarily available to these organizations. But rarely will it be possible to secure extraordinary assistance to these departments for the furtherance of a malaria program. Consequently the program must be of the utmost simplicity, taking full cognizance of the fact that the work of a county health department is necessarily varied, and placing a judicious restraint upon an enthusiastic optimism that would expect to effect the execution of the plans in a year and a day.

(B) *Malaria Morbidity Reporting.*—Improvements in the reporting of malaria cases is felt to be necessary for control work. The present reporting system does not individualize the cases reported, consequently the present reports cannot serve as the foundation upon which to formulate and execute plans for control. In order to achieve this purpose, cases must be reported individually with full particulars given concerning the place of residence. Because of the number of reports that physicians will be required to make, efforts should be made to simplify the reporting.

As a corollary to the efforts to improve morbidity reporting should come the effort to improve the standards of malaria diagnosis. The employment of this term as a catch all diagnosis for obscure conditions should be discouraged and on the other hand every effort should be made to increase the proportion of diagnoses which are based on blood examinations. To further this aim physicians are gratuitously furnished, through whole time county health departments, with simple outfits for the collection and transmission of diagnostic specimens.

County health departments are expected to maintain and currently post with the latest data malaria maps of the county on which are located, according to place of residence, every blood verified case of malaria whose existence is ascertained either from monthly summary returns received from the state laboratory or from the county health department laboratory or through cooperation with private clinical laboratories.

Such maps will go far to reveal the principal local endemic centers within a county.

(C) *Screening of Rural Tenant Houses.*—The perfection of the technic of screening rural tenant houses through the studies of the United States Public Health Service is, in our opinion, an outstanding contribution to the solution of the problem of rural malaria control. The possibilities for the extension of this practice through the whole time county health departments are great.

Through the cooperation of the Bureau of County Health Work of our Board, health departments situated in the Yazoo Delta are commencing an energetic campaign during the present winter in preparation for the season of 1930

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*Read before National Malaria Committee (Conference on Malaria), meeting jointly with Southern Medical Association, Twenty-Third Annual Meeting, Miami, Florida, November 19-22, 1929.

†Director, Bureau of Malaria Control, Mississippi State Board of Health.

MALARIA CONTROL IN ALABAMA, 1928*

By Stuart Graves M D †
Montgomery, Ala

At this season of the year it is difficult to summarize activities for the current year so this present report covers activities for 1928

Except in impounded water areas malaria control is included as one of the functions of county health departments and the State acts in an advisory capacity only Engineers are available to make preliminary surveys and advise as to the best means of control but the details of supervising control measures rest with the county health departments

During the year 1928 surveys and estimates of the cost of control were made in twelve municipalities In addition seven rural areas were surveyed to determine the extent of the problem and the most feasible means of control It was realized that the personnel of many of the units was in need of detailed training and steps were taken to provide this

The control of the impounded water areas remained with the central organization Seventy inspections were made of the 82 projects in the State Some of the small ponds were not visited but all the important projects were kept under supervision Nine of the larger areas made weekly reports as to control work done and the status of breeding throughout the season

Due to excessive rainfall early in the season conditions were particularly suitable for the breeding of *A quadrimaculatus* and there was a considerable increase in the malaria incidence This was particularly true of some of the densely populated rural sections around natural bodies of water There was no increase from the impounded water areas

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Third Annual Meeting Miami Florida, November 19 22 1929

†Temporary Acting State Health Officer

MALARIA CONTROL IN GEORGIA*

By L M Clarkson
Atlanta, Ga

Due to an exceptionally heavy rainfall in 1928, over 10 inches excess above normal, malaria showed a decided increase over previous years, maintaining this high increase in 1929 To date there has been an excess for 1929 Although this condition was somewhat discouraging to those connected with malaria control, it brought great benefit by arousing public sentiment to the seriousness of the problem and to the necessity for greater efforts for control An interesting fact has been the shifting of malaria foci to sections normally only slightly affected This condition has caused considerable alarm and has consequently stimulated prompt action toward eliminating the problem in order to avoid annual repetition One outstanding result has been the initiation of organized county health work specifically for malaria control During 1929 at least six counties adopted specific campaigns for malaria control augmented by the State Board of Health with special sanitary engineering assistance Practically all of these counties have accepted engineering service from the State Board of Health in drainage surveys, mapping planning and estimating costs Municipalities have also expanded their drainage and larvicidal control methods to an extent heretofore unequaled

Control of impounded waters by the State Board of Health has expanded To date there are approximately forty impounded areas for hydro electric development purposes comprising over 100 000 acres involving over 50 counties all of which are under careful observation or under intensive malaria control This feature of the work is operated under permits issued by the State Board of Health It is followed by clearing of all vegetation and subsequent mechanical larvicidal control measures during Anopheles production season The two prime methods of malaria control in Georgia are through drainage and impounded water regulations drainage to eliminate natural and useless waters on the one hand, and regulations to control artificial and necessary waters on the other

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Third Annual Meeting Miami Florida, November 19 22 1929

the local county has organized a full time health unit in Miller County where the project is located and has made recommendations to the Power Company which its officials are now taking steps to carry out

MALARIA CONTROL ACTIVITIES IN NORTH CAROLINA*

By Chas O H Laughinghouse M D †
Raleigh N C

The malaria control problems in North Carolina lie principally in the eastern part of the State that is in a tier of counties about two in width extending along the Atlantic Coast

There are at present 43 full time cooperative county health organizations within the State and twelve of these are situated in the eastern section of what is known as the Malaria Belt Each county has a malaria rate sufficiently high to make the disease of public health importance

The Malaria Belt of the State comprises a total of 33 counties It is within these counties that the harmful effects of the disease are felt and where the Board of Health has concentrated its efforts toward control through the organization of full time county health units with adequate personnel to handle the situation of the prevalence of the disease as its economic importance in each county may demand

The Board of Health believes that malaria control or at least malaria reduction on a county wide basis is well within the realm of possibility for the average county health department This fact has been strikingly demonstrated in certain counties in the eastern section of the State

It is the purpose of the Board to continue to extend measures for the control of malaria as rapidly as the organization and funds will permit The problem which confronts us for 1930 is the impounding of water for hydro-electric purposes The plan now in effect for handling such problems is to extend malaria and mosquito surveys over the areas of any proposed project for at least twelve months prior to the impounding of water for the purpose of determining what if any influence the impounding of water may have upon the mosquito rate or malaria incidence The same measures employed prior to the impounding of water may be extended over a period of at least twelve months after water has been impounded By such methods it is hoped to obtain comparative data which may be used as a basis in formulating rules and regulations for the control of similar projects

The department assuming the administrative duties for the investigation and control of malaria fevers is the Bureau of Epidemiology This Bureau has assigned to it a full time malariologist who devotes his time to the promotion of control measures The primary object is the mapping out of the malaria problem in all the counties within the malaria zone and instructing employees of local county health units in measures for the control of the disease There is a secondary object of even greater importance that is the stimulation of permanent interest and activity in public health work in general and the local demonstration of methods whereby disease prevention can be carried on economically and on a large scale by free and generous support of full time local health departments

MALARIA ACTIVITIES IN SOUTH CAROLINA*

By A E Legare †
Columbia S C

We had an immense carry over of malaria in 1928 and during the spring of this year owing to floods the case rate was greatly increased However there was fortunately no increase in the case rate over last year

Unfortunately in our State for the past four years our malarial section which is an agricultural section has been very hard hit and no drainage propositions of any kind could be undertaken Therefore most of our work has been along educational lines We have tried to induce the people to use proper control measures and we have advocated screening and quininization

Our educational program was greatly helped by lectures at a meeting of four or five thousand farmers and their families at our Agricul

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†State Health Officer

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†Sanitary Engineer State Board of Health.

though at no time will the matter be dropped until screens are as well recognized a part of house equipment as the roof

It is our conviction that the establishment of one or at most a few centrally located screen door factories operated by private capital is a more effective arrangement since it reduces the load of administration the health officer carries as well as freeing him from vexatious questions of credit and collection

(D) *Promotion of Minor Drainage*—In our Delta section the malaria carrying *quadrimacu latus* breeds practically everywhere that water is found Any extension of drainage will therefore reduce breeding opportunities In order to pro mote drainage and assist in making people drainage conscious an engineer has been as signed to the health departments of three coun ties whose services are free to any municipality or private land owner for the solution of drain age problems He will make surveys giving the property owner lines and levels necessary to en able him to execute his work The service is proving popular and a waiting list of applica tions now exists

(E) *Educational Work*—The persistence of endemic malaria in the United States is proba bly in the greatest degree attributable to ig norance The education of the people who suf fer from this scourge is probably the most ef fective work that we accomplish

The screen wire cloth manufacturers have agreed to cooperate with our own and adjoining states during the coming year in a campaign to promote knowledge of the benefits of screening Further information will be available from their representatives

We intend to make a special effort to inform negroes of the malaria situation as it affects their race, and are making plans with this end in view

(F) *Current Malaria Incidence*—From avail able information, the malaria incidence of the current year in the Yazoo Delta was less than during 1928 Elsewhere in the State the dis ease appeared stationary or slightly more in tense, particularly along the Gulf Coast

MALARIA CONTROL WORK IN MISSOURI, 1929*

By W [redacted] Petty, M D,
Jefferson City, Mo

Malaria is a minor problem in the State as a whole but it is a major problem in the South eastern sections of Missouri comprising an area of seven counties

Dr James Stewart, State Health Commis sioner, and W Scott Johnson Public Health Engineer have started direct control measures in these counties along the following lines edu cation, screening individual farm ditching and ditch maintenance This work is being carried out by the county health departments of which there are five two counties of the area not hav ing full time public health work

Several different school districts have inaugu rated a campaign for screening One complete school district was screened and after screenin showed a 42 per cent reduction in the number of malaria ca es

Some studies were made at the suggestion and with the help of Mr LePrince regarding the feasibility of Paris green dusting of drainage ditches This project will be continued next season more extensively

There has been practically no interest dis played by the communities in our malaria sec tion Interest in this work will have to be stim ulated and it will be our aim to keep working in this area It is hoped that more interest can be stimulated and every effort will be made by the full time units in the malaria section to increase control measures

At the present time a large impounded project is under way on the Osage River a short dis tance from Jefferson City In recent years very little malaria has existed in the basin of this water power project During a recent mosquito survey a fairly high proportion of *quadrimacu latus* mo quitoes were found This area is close to the Missouri River bottoms where localized outbreaks of malaria occur

With the large influx of laborers with some from malaria sections who might be carriers, the State Board of Health working in cooperation with the United States Public Health Service and

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*Read befo e National Malaria Committ e (Confer ence on Mala ia) m ting conj intly with S uthern Medical As ociation Twenty Thi d Annual M eting Miami Flo ida November [redacted] 19 9

the metropolitan area and selected schools in Tipton and Obion Counties. Community surveys for malaria and *quadrimaculatus* adults were made in Dyer County in connection with the experimental work with Paris green and in Lake County as a follow up of survey made last year

Anopheles Breeding—In Dyer County weekly or semi weekly visits were made to a large number of catching station in order to follow the trend of breeding and the number of adult *quadrimaculatus* mosquitoes The entire County was surveyed for the location of probable breeding places and observations were made on the rise and fall of the flood waters of the Mississippi and its tributaries in this County

Malaria Laboratory—A special malaria laboratory was established in Dyersburg for the purpose of facilitating the survey work and the studies of Anopheles breeding This laboratory also examined several hundred blood specimens for malaria sent in by physicians in West Tennessee Reports of the results of these studies and of the screening work are to be made separately

Paris Green Studies—Tennessee was again fortunate in having the cooperation of Mr J A LePrince and Mr H A Johnson of the United States Public Health Service for the study of methods for dealing with the extensive *quadrimaculatus* breeding places in the bottom land Dyer County was made the center of activity Paris green was applied by various method of dusting to an area of about 110 square miles and estimates were made of the cost and effectiveness of the work A separate report of this work is elsewhere presented

Other Control Activities—In addition to this intensive program in West Tennessee the Department has assisted the following 22 cities in mosquito control Memphis Covington Ripley Halls Dyersburg Tiptonville Ridgely Union City Martin Dresden Trenton Humbolt Milan Jackson Cowan Brownsville Nashville Franklin Murfreesboro Cookeville Chattanooga and Greenfield The methods used in these cities have consisted of drainage oiling and dusting with Paris green

The Department has also supervised the control of Anopheles breeding on two impounded water projects those of the Tennessee Electric Power Company at Rock Island and the City of Cookeville at the Falling Water River Reservoir

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MALARIA IN VIRGINIA*

By HARRY G GRANT M D
Richmond Va

I have no written report on malaria control in Virginia as the small amount of work done this year hardly justifies one

Malaria in Virginia is chiefly in the Tidewater section of the State in which section there are ten counties under control of medical health officers with a total population of 250 000 people All of these counties have been surveyed *quadrimaculatus* breeding determined and records have been kept The amount of breeding and the amount of malaria has become so small that this year I have requested the health officers to limit their activities to the investigation of cases reported

Our records show that in the State there were 3 861 cases of malaria reported in 1921 with 1 106 in 1928 The number of deaths reported in 1921 was 43 compared with 13 deaths reported in 1928 To check our reporting particularly since malaria has increased in other Southern states a survey was conducted in November 1928 This survey was carried on with the cooperation of Dr L L Williams Jr of the United States Public Health Service The parts of the State surveyed were those in which we knew from experience that malaria had been prevalent in the past A thick blood smear was used in this survey So far out of 6 211 thick bloods taken in Nansemond James City County Princess Anne Cumberland Greenville Southampton and Isle of Wight there have been 43 positives

We still carry on our educational work throughout the State This year circulars were distributed in 21 counties dealing with malaria control and the value of screening

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tural College. Our impounded water regulations are strictly enforced with good results and we have induced practising engineers to incorporate these regulations in their specifications for water systems having large storage basins.

Regarding the question of labor camps, we are now in the era of large road building construction. The State Highway Department has incorporated our camp regulations in its specifications, the main part of these regulations being that camp foremen are required to report to local health authorities any cases of sickness in the camps and upon their report these cases are promptly investigated. Of course most of these cases are malarial.

The State Highway Department is also co-operating with us in requiring proper drainage of borrow pits on all new work and in the case of old work our engineers go over different divisions and indicate control measures to be adopted in existing borrow pits and improperly placed culverts.

We are continuing our educational program among engineering students by lectures to such classes at our three universities. These lectures have been carried on for the past three years and we now have engineers on our roads and other work who have been to a certain extent informed as to their responsibility for malaria prevalence.

This covers the special work done by us during the past year.

MALARIA CONTROL ACTIVITIES IN TENNESSEE, 1929*

By E. L. BISHOP, M.D.,† Nashville, Tenn.

Extensive and intensive studies of our malaria problem in the western section of Tennessee were carried out this year with Dyersburg as a field base. All of the counties bordering on the Mississippi River in this State now have full-time health departments, Tipton County starting on a full-time basis on October 1. These border counties average from twice to several times as much malaria as the neighboring counties not bordering on the River. Moreover, both mortality records and surveys indicate that malaria is on the increase in West and Middle Tennessee.

Owing to the importance of malaria in the counties bordering on the Mississippi River a definite study and control program has been developed during the past two years. This program consists of:

(1) Screening and mosquito-proofing houses on a county-wide scale.

(2) Studying malaria by school and community surveys.

(3) Studying Anopheles breeding.

(4) Experimenting with Paris green as a larvicide in order to ascertain the most effective method of using it in the territory concerned.

The assistance of the United States Public Health Service and of the Department of Preventive Medicine of Vanderbilt University has been secured in carrying out this program.

Screening and Mosquito-Proofing of Houses.—Early in 1928, a county-wide screening program was inaugurated in Lake County. To date 81 per cent of the rural homes in this County have been screened and the owners of an additional 8 per cent report that they will screen as soon as the present cotton crop is harvested. The local screening committee is aiding the local health department in persuading the remainder of the property owners to do screening, so that Lake County can be completely screened, if possible, by June 30, 1930.

Lauderdale County has mosquito-proofed all of the 58 houses on the Henning Farm as a demonstration preparatory to more extensive operations in 1930.

Shelby County has launched a county-wide house mosquito-proofing program and a rotating fund has already been secured for the work. The County's entire force of sanitary inspectors has been trained in measuring houses and estimating the cost of screening and other mosquito-proofing work, as well as in the making of the doors, hanging them, and actually doing mosquito-proofing work in the field. The County has built equipment for two screen door producing units.

School and Community Surveys.—Blood surveys of all the schools in Lake and Dyer Counties were made in the spring and again late in the summer. In August and September surveys were also made of all the schools of Lauderdale County, all the schools of Shelby County outside

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†State Health Officer.

SUMMARIZED DATA ON MOSQUITO CONTROL WORK IN TEXAS TOWNS—1929

Town	*Sponsor*	*Budget or Allowance*	*Nature of Control*
Austin	City	$1 200	Oiling
Bonham	City	Salary 1 man	Oiling
Bryan	City	$1,500	Oiling
Cameron	City		*Not stated*
Cisco	City	1 man full time 2 men part time	Oiling fish
Eastland	City	Salary 1 man	Oiling inspection
El Paso	County	$3,500 and all necessary equipment	Oiling ditching etc
Farmersville	City	Regular inspection force	Oiling fish education
Galveston	City	$300	Oiling
Grapevine	City	As needed	Oiling
Greenville	City	Amt needed Salary of insp and laborers	Oiling fish inspection
Hebbronville	City		Oiling ditching
Henderson	City	$1 500 and 1½ mens salaries	Ditching and oiling
Honey Grove	City Lions Club	Part time health officer Lions Club $100	Oiling etc
Houston	City	$14 500	Oiling ditching etc
Keltys	Lumber Co	1 man full time	Oiling etc
Leonard	City	1 man part time	Oiling
Longview	City	$1,500	Oiling only
Lufkin	City	$1 500 or more if needed	Oiling
Mineral Well	City	1 director 1 part time inspector	Oiling fish etc
McKinney	City	1 inspector	Oiling
Palestine	City and Mo Pac	$2 000 on 50 50 basis	Oiling education etc
Paris	City	Some	Oiling
Pittsburg	Chamber of Commerce	$250 $500	Inspections educational
San Antonio	City	$6 000	Oiling (year round work)
Sugarland	Sugarland Industries	As needed—constant	Fish drainage
Texarkana	City	$3 600—Texas and Ark 50 50	Oiling
Trioli	City	Part time inspector	Drainage oiling
Tyler	City	$4 000	Ditching oiling fish
Waco	City	$1 500	Oiling
Weatherford	City	$65 per month	Oiling fish

The above information was submitted on forms sent out to the city officials in the malarial section of the state and picked up by our field men in their routine inspections The towns listed include only about half of those that conduct malaria control work but it is rather difficult to get a report from every town

Federal bulletins which were available but the supply at most is always far short of our needs for use in schools

Methods of eradicating malaria in Texas include those used in other sections since the discovery of the mosquito as the carrying medium of malaria Probably more oiling is done than any other measure since the larger towns have pretty well eliminated the standing water menace along the streets through liberal street paving programs However in the smaller towns drainage is still much in vogue Crank case oil or crude oil mixed with kerosene has predominated A few towns have used minnows but the varying stream flow in most of the dry weather streams through a town makes this means rather a losing proposition The use of Paris green as a larvacide has not been employed to any great extent In some sections as at Orange it is claimed that the large amount of waste oil from the oil fields has practically eliminated the mosquito Of this we are somewhat doubtful however

Morbidity reporting in Texas is at a low ebb Nevertheless we were able to compile figures showing the incidence of at least 16 000 cases of malaria from our incomplete reports In many counties in the malarial section not a case of malaria is reported to have occurred Even with these incomplete reports the section in which malaria is endemic is fairly well defined

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THE AIMS AND OBJECTIVES OF THE GULF AND SOUTH ATLANTIC ANTI MOSQUITO CONGRESS*

By HON HARRY T HARTWELL †
Mobile Ala

The little pest known as the mosquito has for generations annoyed and punished the people along the South Atlantic and Gulf Coast section of this country and its destruction has been a

*Read before National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Twenty Third Annual Meeting Miami Florida November 19 [illegible] 1929

†Mayor of Mobile Alabama and President Gulf and South Atlantic Anti Mosquito Cong

MALARIA WORK*

By John A Ferrell M D,
New York, N Y

The International Health Division of the Rockefeller Foundation has only one member of its staff engaged in malaria work in this Country at present This is Dr Boyd who is serving as Malariologist with the Mississippi State Health Department No independent studies are being undertaken in the United State

We are giving financial aid to and through five state health departments, mainly toward the compensation of directive personnel that devotes itself to malaria survey and control measures in cooperating with the local authorities Dr Earle has reported his activities in Porto Rico, which our organization is supporting

FIELD INVESTIGATIONS OF MALARIA*

By E R Coffey M D †
Richmond Va

The office of Field Investigations of Malaria has been primarily interested during the past year in determining the efficacy and relative cost of county wide malaria control with Paris green dusting In one county dustings were made at ten day intervals and in another county at thirty day intervals Data on these two projects are now being compiled and soon will be ready for publication in the Public Health Reports

Some experimental work has also been done with calcium and aluminum stearates as diluents for Paris green The stearates being much lighter than the hydrated lime ordinarily used it was hoped that Paris green would be held on the surface of the water a longer period of time thereby extending the period of toxicity of Paris green to Anopheles larvae Our few experiments bore out this expectation to some extent With lime as a diluent larvae were found to be absent after dusting on an average of three days, after dusting with stearates as diluents the larvae were not found present until an average of five to six days The results obtained warrant further experiments along this line The report of these experiments was published in the Public Health Reports of October 25, 1929

The fact that we are receiving reports of malaria from localities heretofore free from this disease is worthy of more than passing interest to this body It seems that in view of this we should all give more consideration to the control of Anopheles breeding whether we have malaria present or not So long as Anopheles mosquitoes continue to be present we have hanging over our heads the potential danger of an epidemic of malaria

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Third Annual Meeting Miami Florida, November 19 22 1929

†Past Assistant Surgeon U S Public Health Service Medical Officer in Temporary Charge Field Investigations of Malaria

REPORT ON MALARIA CONTROL WORK IN TEXAS 1929*

By J C Anderson M D,†
Austin Texas

Early in the year we sent out a letter to the city officials in all towns in east Texas and other sections wherein malaria control work has been carried on in the past and enclosed a questionnaire asking for certain information to be furnished Our field men also filled out questionnaires on those towns visited by them Not all of the malaria control work is represented by the list attached as many city officials ignored the questionnaire and our representatives failed to reach all towns

In general our program is an educational one since we have only two or three field men at the most who can work the malarious belt Of course in those towns where organized work has been under way for a number of years the field man merely checked up or reminded the officials to include something in their budgets for mosquito control In other towns where organization was needed some time was spent with the officials in going over the methods by which a malaria control program may be mapped out and actual field work done with the inspection force to lead the way In some towns that were not reached by representatives of the department letters were written and the attached outline for an educational campaign furnished In 1929 we had very little money for printing therefore our supply of printed matter for education work was extremely limited We made liberal use of all

*Report to National Malaria Committee and received by Secretary after proceedings of annual meeting had been published in Southern Medical Journal for May 1930

†State Health Office

sources relating to the problems of different regions For the studies in detail most of the work has been conducted from the field headquarters of the survey at Biloxi Mississippi while other intensive studies have been carried on at points in Florida and North Carolina and at present in one point in Louisiana

Time will not permit in this brief paper to dwell upon the mass of information already obtained by the preliminary survey However it will be in place to take up something of the types of mosquitoes their habits some suggestions as to control measures and the interests concerned in the problems when the permanent survey begins

DISCUSSION (*Abstract*)

Dr George N MacDonell Miami Fla—I should like to ask to what extent *Anopheles atropos* is found in this salt marsh area and to what extent it has proven to be troublesome

Dr T H D Griffitts Albany Ga—*At opos* was found breeding more or less profusely in parts of salt marshes in Alabama Mississippi and Louisiana It was not found in this survey outside of these three states It is strictly a salt marsh mosquito breeding in salt water of a salinity as high as 17 per cent No work has been done on its ability to transmit malaria There has been no experimental work carried on It has a habit of getting into occupied houses and like *quadrimaculatus* can be found at distances of one mile from the breeding ground

We had intended to carry on transmission experiments in 1927 in cooperation with Dr Barber but just at that time a proper gametocyte carrier could not be found.

problem which has baffled many peoples through the ages

Along the Jersey Coast and down through the Carolinas, a determined effort has been made to eliminate it without much success and efforts have been made along the coastal regions of the Gulf and South Atlantic with this aim in view Our Government has to some degree aided this cause and from all of this work came the creation of the Gulf and South Atlantic Anti Mosquito Congress The first meeting for considering ways and means for eradicating the mosquito pest was called in New Orleans Louisiana October 2 1925 by the late Mayor Martin Behrman The result of this meeting brought about a later meeting in Mobile after which a conference was called in New Orleans to effect the permanent organization of the Gulf and South Atlantic Anti Mosquito Congress This Congress is made up of representatives of eight of the Southern states namely North Carolina South Carolina Georgia Florida Alabama, Mississippi Louisiana and Texas, many of which attended the Conference in New Orleans Our aim and objective is thorough cooperation with a view of destroying the mosquito throughout the coastal regions of the South Atlantic and Gulf of Mexico territory Our Congress has already called upon the Senators and Congressmen from the eight states represented in our Congress for National aid and in almost every instance assurances were received that an effort would be made in the Sixty first Congress, assembling in December to have sufficient funds appropriated for the United States Public Health Service to go forward with a detailed survey of conditions This survey will be followed up by an intensive drive and it is the intention of the various members of our Congress to ask the state legislature of the various states whose interests are involved as well as the counties and cities affected by this movement to contribute funds for the prosecution of the work In this manner we hope to obtain sufficient money eventually to eliminate the mosquito from this section of our country

In the South Atlantic and Gulf states from Virginia to Texas both inclusive there are vast tracts of low lying lands that are wet and covered more or less by tides These constitute the "salt marshes" In these states there are 5 600,000 acres of salt marshes, in round numbers as follows in Alabama, 34,000, Florida, 680 000 Georgia, 329,000, Louisiana, 3,381,500, Mississippi 26,000, North Carolina 427 000, Texas, 315,000 Virginia, 206,000 From these figures it will be noted that within the State of Louisiana there is 58 per cent of the total salt marsh acreage of the South Atlantic and Gulf states, and it is of interest to know that in that State are half of the salt marshes of the United States

To one unfamiliar with problems of this nature, these enormous figures might discourage support of the efforts at control Although there are millions of acres of salt marshes in the South Atlantic and Gulf states, the Public Health Service feels that the task of control is not a hopeless one In the first place, the preliminary survey by the Government has brought out the fact that the character of the marshes varies widely and that only a few of them are actual, or even potential, breeding areas In many sections vast expanses of marshes are daily covered at high tides These are not producers of mosquitoes Consequently, one of the first objectives of the survey was the classification of the marshes according to tidal and other influences which bear a direct relation to salt marsh mosquito production

With the limited funds at the command of Dr T H D Griffitts, United States Department of Health, who conducted the survey, the short time and a coastal zone extending from Norfolk, Virginia, to Brownsville Texas in which to determine the exact breeding places of the salt marsh mosquitoes ' it was necessary to conduct the survey along definite lines, namely selection of (a) certain more or less typical areas in which to conduct intensive studies of the species of mosquitoes, their egg laying habits, larval development flight habits and conditions influencing these, character of soils and vegetation, influence of tides and climatological conditions natural aquatic and aerial enemies larvicides and other methods of control under varying conditions, and (b) more or less rapid surveys in marsh areas over the whole coastal territory and the collection and compilation of reliable data from all available

SYMPOSIUM ON MALARIA

Papers and Reports Presented before the National Malaria Committee, meeting conjointly with the Southern Medical Association at its Twenty Fourth Annual Meeting, Louisville, Kentucky, November 11 14, 1930

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SYMPOSIUM ON MALARIA

SOME SUGGESTIONS RELATIVE TO OUR MALARIA CONTROL ACTIVITIES*

By J A LePrince †
Memphis Tenn

Senior Surgeon H R Carter United States Public Health Service never told anyone of the part he took personally in the early campaigns against mosquito borne disease He was content to confine his conversations to inducing *others to become pioneer campaigners but we* can yet see and feel the influence of his unselfish attitude and activities The people of the southern part of our own country as well as those in the republics to the south of us hardly yet realize the big part which he took in bringing about the elimination of the deadly yellow fever epidemics that raged through the Americas for centuries He also watched and studied the pioneer efforts against malaria in Cuba and again at Panama and decided that sufficient information was available for us to begin eliminating malaria *fevers from our southland Without any funds* and without assistants he started anopheles control campaigns in Virginia and North Carolina in 1913 We all learned to know him well and to love him as well as to absorb his teachings *that we later applied to practical advantage*

Likewise old malaria field workers here and many of them without *knowing of it are most* decidedly under obligations to the Father of Mosquito Control Dr L O Howard who is yet with us for it was he who back in 1882 used coal oil as a means of destruction of mosquito larvae

We all know Dr Frederick Hoffman who conceived the idea of originating our National Malaria Committee brought it into existence thirteen years ago and has taken an active part in its growth and progress

Undoubtedly all countries which have serious malaria problems owe a debt of gratitude to these *three pioneers* and your Chairman is decidedly convinced that most of you would like to see this debt paid I wish to ask you how in your opinion this could best be done

It would appear that we as an organization can best do our part by making the National *Malaria Committee of more practical value to* all malaria field workers throughout the western hemisphere by vitalizing our sub committees and by making a greater effort to carry out some of the projected studies and activities suggested *in Dr Hoffman's A Plan and A Plea*

Our constitution and by laws should be so modified as to bring about this desirable change Why should we allow ourselves to get into a rut?

A well known professor of one of our leading universities recently made a statement to the effect that he did not see the advisability of directing a dead sub committee and that statement is worthy of serious consideration by each member of our organization

We should feel much more cheerful about this if we were able to say at the close of the 1931 *conference*

> At last every sub committee has made decided progress and we have given something worthwhile to those that are to follow in our footsteps

If we analyze our past efforts in a constructively critical manner we shall find a lack of courage in our method of attacking the apparently impossible problems that face us

We shall also find there has been a tendency *to repeat investigations while a large number of* important problems are yet to be solved and should be investigated and solved so we may have the answers to problems that every field worker and many county health officers are decidedly anxious to obtain

One reason for the above is that our annual programs have been too long and the business or executive sessions too miserably short and it is high time a change was made so that our viewpoints may be broadened and our accomplishments more satisfactory

During the past year or two some of the county health officers have done most important work of a practical investigational character which should have been sponsored by this Committee In my own State a county health officer with a very small fund has shown the same *audacity and courage that was characteristic of* Dr Gorgas and the results are wonderful

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*Chairman's Address National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†Senior Sanitary Engineer U S Public Health Service

The fact that we are about to face a year of reduced local appropriations should not decrease the total amount of anti malaria activities that can be accomplished by county health units and state health departments in the five hundred counties that have malaria problems

In a half dozen counties considerable permanent work has been accomplished where the county health officer obtained temporary use of the labor of the county prisoners One county recently installed 13 000 concrete slab sanitary privies made largely by prison labor, while another county used fifty county prisoners to install eighteen miles of ditches While this work was going on there were a number of county seats which were surrounded by prolific sources of *Anopheles quadrimaculatus* within Anopheles flight range of the office of the county health unit and of the county jail Where we allow such conditions to exist can we say we have a well balanced program?

It is encouraging to note that decided progress is being made in Louisiana, Mississippi and in Tennessee and Georgia in relation to county wide malaria control

With regard to screening of farm tenant homes even though financial conditions may affect progress it is and will be possible to improve the mosquito proofing of thousands of rural homes that are now screened but not Anopheles-proof

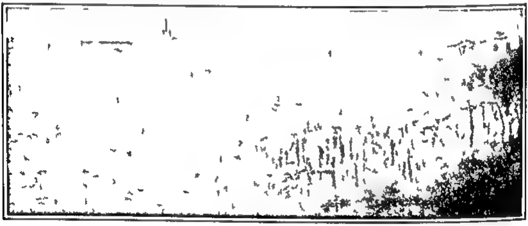
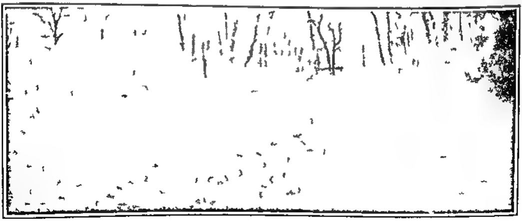


Fig 1

Close to the court house of this county seat where the full time health unit is located are prolific sources of anopheles. The anopheles propagation area shown is ten feet above river water level and only two hundred feet away



Fig

The outlet ditch of the anopheles breeding place shown in the picture has been clogged up for the past five years Why Plenty of county prison labor was available to keep it in effective condition

We have definite information that it is possible to make and install low cost substantial screen doors that will last more than eight years and as time goes on there will probably be a tendency to have the same built by contract and to rely to a large extent on this means of malaria control in rural areas

Unless proper precautions are taken it is quite possible that defective screen doors will be sold by recommendation of county health units with disastrous results

After visiting a large number of county health units over a period of years I am firmly convinced that proper training and effective stimulation of sanitary inspectors is the most important item in our county malaria control activities and if we pay more attention to this item we can double what we are now accomplishing in county wide control work This matter is not receiving the attention that it should have As it is not possible to have the inspectors at our conferences we should see to it that a copy of the annual proceedings of this Association is given to each county sanitary inspector of counties having a malaria problem

As the effective screening of farm tenant homes can be of decided value in preventing transmission and bringing about reduction of typhoid dysentery and summer sickness of small children as was definitely proven at Panama it is most important that county health officials and those supervising activities of rural sanitation give this matter the consideration it should have

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THE MECHANISM OF ACQUIRED IMMUNITY IN AVIAN MALARIA*

By WILLIAM H TALIAFERRO PHD
Chicago Ill

The nature extent and even the possibility of acquired immunity in malaria of man are much discussed questions I thought therefore that you might be interested in a study of a clear cut case of acquired immunity in bird malaria True it is an immunity to superinfection and exists only as long as the initial infection persists but to rule it out on that score necessitates ruling out such well known cases as the immunity in tuberculosis Of course *how far the results in* the avian disease can be applied to the human infection cannot be definitely known until much more work is done on human malaria

For several years in collaboration with Dr L G Taliaferro and Dr Paul R Cannon I have been engaged in ascertaining the factors involved in the very effective immunity which birds develop against *Plasmodium cathemerium* This parasite is very similar to *P vivax* and *P malariae* but is transmitted in nature by certain culicine mosquitoes In the bird the asexual cycle as has been shown by L G Taliaferro (1925) and others takes regularly 24 hours with gametocytes in small numbers occurring more or less regularly throughout the infection A typical infection observed in canaries according to the Sergents (1918) and others is characterized by an incubation period of several days depending upon the number of parasites injected and the route of injection an acute period as shown by a rapid rise in the numbers of parasites until sometimes every other cell is parasitized then if the bird does not die which occasionally happens a crisis during which the majority of the parasites disappear even more rapidly than they accumulated the developed infection of a week or more when a few parasites may be found in the blood and the latent infection of many months and even years during which parasites cannot be found unless a relapse due to a lowering of the bird s resistance occurs The latent period is of unusual interest in our work because it is the period after the bird has overcome the initial acute infection One outstanding fact characteristic of this period is that the parasites although they cannot be found are still present in the bird and can be demonstrated by inoculating comparatively large quantities of blood from such birds into normal birds as has been shown by Wasielewski (1901) Whitmore (1918) and others In fact Mazza (1924) found that parasites could be demonstrated in this way in a bird four years and two month after the original inoculation Furthermore Moldovan (1912) and Ed Sergent and Beguet (1912) ascertained that birds were only immune to a second attack as long as the latent infection persisted whereas upon complete recovery they could become reinfected Recently Kikuth and Tropp (1927) confirmed the fact that birds were refractory to superinfection for as long as 5 months subsequent to infection

As the first step in analyzing the factors in this immunity to superinfection we (W H and

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*Read before National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

L G Taliaferro, 1929) attempted to study it more quantitatively by ascertaining the rapidity and extent to which birds during a latent malarial infection can rid themselves of parasites injected directly into their blood stream in massive numbers as compared with normal birds The outstanding advantage of such a study over previous work is due to the fact that so many parasites can be introduced intravenously that they can be found immediately after injection and observed thereafter

For this part of the work 81 immune birds and 16 normal birds were studied after the intravenous injection of parasites The immune birds were obtained by injecting parasites intraperitoneally and making, staining and examining blood smears to insure that infection had taken place Then at some time during the latent period when it was found that there were no longer parasites present in approximately 10,000 red blood cells, the birds were injected intravenously with heavily parasitized cells Within a few minutes and for a week or more thereafter blood smears were made from which the numbers of parasites per 10,000 red blood cells were ascertained The type of results encountered is clearly brought out in *Fig 1* The experimental bird, that is, the immune bird, on the forty third day of its primary infection when there were no longer parasites in its blood and a normal bird, were given similar intravenous doses of parasites at 1 00 p m so that a few minutes later there were 8 parasites per 10 000 red blood cells in their blood The sequence of events in the two birds was strikingly different. Whereas in the experimental bird the parasites had disappeared by 10 00 a m the day after the intravenous injection and never reappeared (the bird died on the eighth day of the experiment), in the control bird they showed a typical course of infection The results were even more dissimilar when larger doses of parasites were given, for the immune birds disposed of their parasites so that they could no longer be found

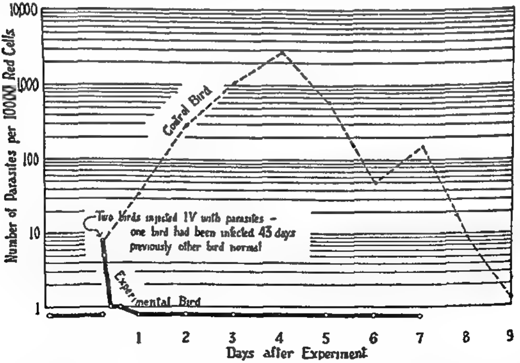

Fig 1

Experiment Showing the Disappearance of Washed Parasitized Cells from the Blood of a Bird in the Latent Infection and the Survival of the Same Type of Cells in a Control Uninfected Bird

Both birds (one with the latent infection and the other un nfected) we e inject d intravenously with nough washed infected cells so that a few minute later b th sh wed an infection of ab ut 8 pa asites per 10 000 red cell In th bird with the latent infe tion these we r moved f om the circulation within twelve hours but in the uninfect d bird they survi d and progre ively increased in numbers initiating a typical infection (After Taliaf rro W H and L G 1929)

2 to 3 days after injection whereas the normal birds died between the fifth to the eighth day with approximately every other cell parasitized

The data from these experiments may be briefly summarized as follows there is a high degree of immunity to superinfection which begins as soon as the latent period sets in and lasts for extremely long periods Thus, birds with latent infections that had been inoculated 16 to 656 days previously, when injected intravenously with large numbers of washed parasitized blood cells disposed of them quickly whereas normal birds could not cope with such enormous numbers and quite frequently succumbed The removal of the parasites in the latent birds depends to a certain degree on the number injected In other words when approximately 1 to 100 parasites per 10 000 red blood cells were introduced they were removed from the peripheral blood within 24 hours whereas when from 100 to 400 per 10 000 red cells were introduced, they were removed within from 48 to 76 hours The parasite red-cell complex is removed throughout the asexual cycle and not simply the merozoites free in the serum as is evidenced by the fact that when hourly blood smears were made following the intravenous injections the decrease in numbers was gradual and not restricted to the time of sporulation The ability to remove the parasites is very labile and very delicately attuned to the physiological condition of the bird and may be upset upon the slightest provocation Thus of six birds with latent infections when injected intravenously 33 days after the initial inoculation 1 showed no parasites the following day 2 got rid of them in 2 days whereas the other 3 took 3 days to dispose of them

In trying to find the basis for this high grade immunity we were helped by the work of L. G Taliaferro (1925) She showed that whenever the parasites were found in the blood they were reproducing at the same rate Therefore the precipitous decrease in numbers of parasites at the time of the crisis and presumably the immunity itself is purely a parasiticidal mechanism and is not associated with any decrease in the rate of reproduction *per se* such as occurs in some trypanosome infections (see W H Taliaferro 1929) We felt that the most promising parasiticidal mechanism for which to search was some type of sensitizing antibody either a lysin or an opsonin Any such antibody generally would be easily demonstrated by testing the protective value of serum from immune that is latently infected birds

Very few investigations have been carried out on the protective or curative property of malarial serum In human malaria Sotiriades (1917) reported apparent beneficial results from the administration to a man with very evident symptoms of three 10 c c doses of serum from a malarial patient with no symptoms at intervals of four and one day respectively In a more extensive series while working with induced malaria Kauders (1927) reported beneficial effects and also presented evidence that immune serum is sometimes protective In bird malaria, Moldovan (1912) did not find any protective property in immune serum when it was left in contact with parasites for 1 hour at 37 C

The protective power of immune serum which has been studied so extensively in trypanosome infections is tested by injecting appropriate serum either simultaneously (or a day before or after) with the parasites in the same or different parts of the body of a suitable animal or by injecting a mixture of serum and parasites after they have been in contact *in vitro* for lengths of time varying from a few minutes to several hours at room or incubator temperature The curative power of immune serum is tested by injecting the serum just as the parasites are appearing in the blood Accordingly in our experiments serum was injected protectively either intraperitoneally or intravenously and either simultaneously or after having been left in contact with the parasites for from 5 to 15 minutes at room temperature or the day after the parasites had been injected it was injected curatively either intravenously or intraperitoneally when there were between 1 and 10 (in a few cases 100) per 10 000 red cells.

Work on trypanosomes has established another fact The present author and Johnson (1926) found that zones of effectiveness and non effectiveness occur in the curative action of immune serum when a graded series of doses of serum is given to mice in which *Trypanosoma equinum has just appeared For example doses of 0 3* c c and 1 1 c c of immune serum might cause lysis of the trypanosomes in the mouse whereas an intermediate dose of 0 7 c c and even a larger dose of 2 1 c c might not cause any observable effect on the trypanosomes Johnson (1929) in a further study found that the zone phenomenon depends on the number of parasites present at the time the serum is administered In view of this work, various sized doses of

serum from birds with latent infections were given to rule out the possibility that the doses administered were insufficient or within the localized ranges of ineffectiveness Such a series had to be accompanied by the injection of para sites into a similar number of normal birds which did not receive serum because quite frequently a series of birds inoculated intraperitoneally as far as possible with the same amount of a homo geneous saline suspension of parasitized red cells shows a wide range of variation in the number of days before the parasites appear and some of them may not even become infected

The sum total of all of the experiments on this phase of the work was negative (W H and L G Taliaferro, 1929) Immune serum from birds with latent malarial infections was not protective in four series when administered to 20 experimental birds receiving parasites and simul taneous doses of serum ranging from 0 02 to 2 0 c c per bird as evidenced by the fact that parasites appeared in the blood of all but one of the treated birds within the same number of days as did parasites in birds receiving no serum The one bird in which parasites did not appear exhibited a typical infection upon reinoculation so that it seems reasonable to suppose that the initial infection did not appear as occasionally happens in normal birds but that the failure was in no way due to the dose of serum

In trypanosome work it is well established that each contact of the trypanosomes with a parasiticidal antibody results in the acquisition of a temporarily inherited resistance to the anti body by the parasites which enables them to re accumulate (relapse) in the blood in the pres ence of the antibody (see Taliaferro 1929) To obviate this difficulty experiments were carried out with a passage strain that is with a strain kept in mice where antibodies do not occur, or in rats where it is transferred every fourth or fifth day before the antibody is formed so that the strain does not become altered In a sim ilar manner the parasites used for the protective experiments in the four series just cited might not be the same as those used to produce the immune serum because between the inoculation of the birds furnishing the immune serum and the carrying out of the experiment the para sites may have been subjected to a lysin and hence may have become antibody resistant Therefore four series of experiments were per formed in which the birds that were to furnish the immune serum were injected with a passage strain, that is the parasites were subinoculated from bird to bird before the number crisis had taken place One series with such a strain seemed to indicate that the serum was thereby rendered protective since in 4 out of 7 birds no parasites ever appeared, but three subsequent series showed no such result that is the para sites all appeared as soon as did those in the control birds Two of the series are particu larly interesting since the three birds in each eries received 4 daily doses of serum of 0 05 0 1 and 0 3 c c, respectively, beginning on the day the parasites were injected but their para sites showed up just as promptly as did those in the control birds receiving parasites alone Moreover, the immune serum itself was from birds which were hyperimmunized, since they had received an intravenous dose of parasites one month after their initial inoculation, namely one week before being killed

Nine series of experiments involving 36 birds indicated that immune serum is not curative when injected in varying doses from 0 02 to 2 00 c c per bird just as the parasites were appear ing in their blood The numbers of parasites in these birds showed no considerable decrease after the serum injections as compared with the numbers of parasites in 18 control birds receiv ing no serum

Another experiment in which parasitized cells were kept in contact with immune serum for 6½ hours and then washed and injected in large numbers into a bird showed that the para sites had not become sensitized, since they in crea ed in numbers just as rapidly as did para sites which had been in contact with the serum from the same bird from which the parasites had been collected

With the failure to find any antibody basis for the immunity, Dr P R Cannon and I* at tempted to find a direct cellular basis for it Many studies of the pathology of human and avian malaria have been carried out but this is probably the first attempt to study systemat ically the histology at various intervals through out primary infections, to compare this with the pathology of superinfection and to correlate these findings with the previous parasitological re sults

The organs of most interest pathologically were found to be the spleen and liver In nor mal birds the spleen was small (2x5 mm) and its microscopic anatomy very similar to that of

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*This w k i to appear in the Journal of Preventive M di ine

the mammalian spleen except that the trabecular tissue was scantier and the follicle less prominent. In general it was composed of lymphoid cells of various sizes and types which were arranged around the arteries and arterioles in sheaths. The lymphocytes nearest the arteries were merged imperceptibly into the typical macrophages of the pulp proper and showed frequent mitoses but at no time did they approach the intense activation seen during the height of malaria infections. In the liver of the normal bird the Kupffer cells and the basophilic lymphoid cells were very inconspicuous. At the height of malaria infection on the other hand the Kupffer cells became swollen and increased in number and the various lymphoid cells exhibited many mitotic figures.

As a groundwork for the study of the cellular basis of the immunity during the latent infection, the pathology of 47 birds killed at various intervals during the course of infection was studied. For the earliest part of the infection birds were injected intravenously with enough parasitized cells so that the organisms could be found immediately after injection.

As early as 4 hours following a primary injection of parasites an occasional parasite could be found in the macrophages of the spleen and liver but there was no indication of an activation of the system. The constant phagocytosis of parasitized red cells continued throughout the acute period. This directly verifies the indirect findings of L. G. Taliaferro (1925) and Hartman (1927) on the great mortality of asexual forms during the primary infection.

Distinct evidences of activation of the mesenchyme appeared after 18 hours. Thus in the spleen basophilic lymphoid cells were more abundant and mitotic figures more frequent; in the liver the Kupffer cells were moderately swollen. At the end of 24 hours the increase in numbers and activity of the macrophages was quite marked.

The activation apparently increased during the acute period until the eighth to tenth day when it reached a climax concomitantly with the crisis of the infection. At this time in the liver the Kupffer cells were swollen and showed marked phagocytosis of malarial organisms while the mononuclear cells with numerous mitotic figures had increased tremendously. The liver cords were also strikingly disoriented. In the spleen the activation was manifested by a diffuse hyperplasia of the lymphoid cells with many mitotic figures, a great increase of basophilic lymphoid cells and a larger proportion of pulp cells (macrophages) showing marked phagocytosis of malarial organisms.

Throughout our study we found phagocytosis of the parasites limited to the macrophages (the so called hemophages of Kyes, Kupffer cells in the liver, pulp cells in the spleen and so forth) of the spleen and liver and to a much less extent in other organs. Since there were very few macrophages found in the bone marrow it seems highly probable, as some authors have suggested, that continued asexual reproduction may occur during latency in this site. Our histological study also indicated that the entire parasite-erythrocyte combination rather than the isolated merozoite is phagocytosed, which substantiates directly the indirect studies of Hartman (1927) and W. H. and L. G. Taliaferro (1929).

After the crisis a gradual decline in evidences of phagocytosis and activation ensued. This can undoubtedly be attributed to the fact that after the body has gained the upper hand very few parasites exist which need to be removed from the blood stream. One outstanding feature of the latent infection was that the pigment and debris which accumulated during the acute period and crisis largely disappeared within 30 to 40 days following the initial infection. This rapid disappearance of pigment allows the study of the pathology of the immunity to superinfection unhampered by the accumulated debris from the primary infection.

The altered reactivity (activation) of the mesenchyme which reached its height at the crisis persisted to a marked extent throughout latency. This is strikingly brought out by the fact that phagocytosis during superinfection (39 birds studied) was well initiated within 15 minutes after superinfection and functioned so successfully that within 24 to 48 hours parasites could no longer be found in the peripheral blood. The activation seemed to decline very slowly as tested by superinfection but was still effective 654 days after the initial infection.

In view of the failure to detect parasiticidal antibodies and the direct observation of phagocytosis of the malaria parasites we believe that the mechanism of immunity is primarily cellular and involves an activation of the mesenchyme. Our evidence furthermore indicates that the activation includes two factors: (a) an actual increase in the number of phagocytic cells and (b) a greatly increased rate of phagocytosis.

The picture might be considered more or less

complete were the activation of the mesenchyme non specific since then of course, the absence of antibodies would be accounted for, but Gingrich (1930) has demonstrated that between *P cathemerium* and *P elongatum* the immunity is specific Thus during a latent infection with *P cathemerium* there is an immunity to a superinfection to *P cathemerium*, but not to *P elongatum* and vice versa This demonstrates that the bird during latency acquires some mechanism which specifically causes its phagocytes to ingest the parasites and suggests some kind of opsonin which we have failed to demonstrate in our earlier experiments

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DISCUSSION (*Abstract*)

Dr H E Meleney Nashville Tenn—Dr Taliaferro has demonstrated conclusively that there is an opsonic or phagocytic antibody in the cells of the reticulo endothelial system of the canary produced by an initial malaria infection and persisting as long as a few parasites remain in the body The presence of this antibody like that of all antibodies is demonstrated by its activity which here consists of an increased reproductive activity and an increased phagocytic activity on the part of these cells. Dr Gingrich s work seems to indicate that the antibody is at least species specific in bird malaria It is probable that if the cells involved were free blood cells like the polymorphonuclear leucocytes the phenomenon could be measured *in vitro* in the form of an opsonic index as is done in studies of certain bacterial infections It might be that in malarial infections this could be done by using Bass method of culturing malaria parasites and observing the intensity of the attraction of the large mononuclear cells for parasitized red blood cells.

The phenomenon described by Dr Taliaferro can be seen in human malaria in autopsies on fatal cases where the Kupffer cells and spleen macrophages are increased in number show mitotic figures and contain many parasitized red blood cells In the therapeutic use of malaria in general paresis Dr Bruetsch s work at the Central State Hospital Indianapolis, suggests that much of the success of this measure depends upon the incidental effect on the treponema of the activation and multiplication of the macrophages in the perivascular tissue

The occurrence of relapses in malaria in the presence of such an opsonic antibody would seem to indicate that there may be a second non specific humoral factor necessary to the activity of the specific antibody or that this activity may be temporarily paralyzed by a loss of balance in the metabolism of the body Another form of deprivation of the protective activity of the reticulo endothelial cells is seen when the spleen is removed In relapsing fever this is necessary in order to produce relapses in some animals and in Babesia infection it often brings out a latent infection

One of the important characteristics of the specific antibody is that it is lost when the parasites are all eliminated from the body This fact suggests that the opsonic activity of the cells or rather their sensitization in preparation for phagocytic activity is dependent upon the continuous presence in the body of a small amount of specific antigen In this respect the whole phenomenon of immunity in bird malaria appears to be a state of allergy or temporary sensitization to the malaria parasite

In clinical human malaria I think there is one important phenomenon which is related to this problem and that is the problem of repeated infections with the same species of parasite There is considerable evidence that in heavily endemic areas persons who already have malaria become reinfected from year to year suffer from clinical attacks and gradually develop greatly enlarged spleens One wonders whether this may be evidence that whatever immunity there may be in human malaria is specific for the strain of parasite within the species rather than for the species as a whole

There is some clinical evidence that the opsonic anti

body is not only species specific but strain specific For instance Nicole and Steele (*Jour Trop Med Hyg* 24 48 1926) stated that their paretics could not be reinfected with the same strain of benign tertian malaria with which they were first infected but could be reinfected with another strain either by mosquito bite or by blood inoculation Strain specificity does occur in other infections in the formation of antibodies in the host Trypanosome infection among the pro*tozoa and relapsing fever* among the closely related spirochete infections are examples of this In relapsing fever both agglutination and lysis occur as evidences of this phenomenon It seems possible that there may be a somewhat similar phenomenon in human malaria which would explain the clinical picture of *superinfec*tions

In conclusion I wish to pay tribute to the macrophage the type cell of the reticulo endothelial system It is perhaps the most versatile cell of the body and its importance in the protection of the body is constantly being more fully recognized Dr Taliaferro has contributed a valuable addition to our knowledge of the functions of this cell in malaria

Dr Walter L Bruetsch Indianapolis Ind—At the Central State Hospital Indianapolis we have had an opportunity to study the organs of general paretic patients who died during the malaria treatment Histologic examination showed in the liver numerous histiocytic lining cells of the capillaries in the stage of transformation into free highly phagocytic Kupffer cells The changes in the human liver were similar to those observed by Dr Taliaferro in the liver of birds In addition we noted in the liver of our patients an activation of the undifferentiated mesenchymal cells leading to the formation of cellular accumulations in the periportal tissue These periportal foci consisted morphologically of mature and immature basophilic round cells Both cell types the histiocyte *or macrophage* and the basophilic round cell have in recent years been identified with the production of natural immunity (Kyes Epstein) From our studies we are inclined to believe that the beneficent effect of malaria in the treatment of *general paresis depends mainly on the* activation of the system of histiocytes accompanied by a new formation of phagocytic tissue The temperature seems to play a subordinate role

Dr Taliaferro (closing)—I think that certainly there is *not* any antagonism between humoral and cellular phases The antibody is primarily in the cells and in some cases it goes into the blood stream

I also agree thoroughly with the conception of nonspecific and specific factor The increase in the number of cells must be *specific and that* is probably the same type of phagocytosis we get on infection

There is a very close homology between Epstein's findings and ours I think in other words this is just one of the phases of the general picture among reactions and not something *specific to malaria* In human malaria if we can accept all the work that has been done it does seem to be strain specificity but in bird malaria only species specificity

PLASMOCHIN IN MALARIA*

By Eugene R Whitmore M D
Washington D C

The history of malaria carries us back 2 350 years to the beginning of scientific medicine with Hippocrates who distinguished intermittent from continuous fevers recognized quotidian tertian and quartan fevers and noted their frequency in summer and autumn and their occurrence near stagnant water

Celsus 1 900 years ago distinguished two types of tertian malaria a simple and a much graver form the tertian and subtertian as we know them today

We come down 1 600 years to the next important advance in our knowledge of malaria the application of cinchona bark in the treatment of the disease and we are now celebrating the tercentenary of that event Quinine was isolated from cinchona in *1820*

We have just passed the fiftieth anniversary (on November 6) of one of the great events in medicine the discovery of the malarial parasite *In 1897 MacCallum* discovered *the fer*tilization process in Hemoproteus and in the subtertian malarial parasite thus explaining the meaning of the crescents and of the process of flagellation In 1898 and 1899 Ross reported his results on the mosquito transmission of malaria

Study during the intervening years has given us much information regarding the epidemiology of malaria susceptibility and resistance and many other points in connection with the disease

Yet with all this array of knowledge regarding the disease malaria remains one of the outstanding scourges of the world and one of the *great problems in tropical and subtropical re*gions Advances have been made on all sides but our discussion today is concerned with the use of drugs in the control of malaria

The treatment of malaria with cinchona and later with quinine is one of the outstanding ex*amples and triumphs of chemotherapy and* I must say here what I have said repeatedly that quinine properly given is the one outstanding drug in the treatment of malaria Osler said

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

that the physician who cannot treat malarial fever successfully with quinine should abandon the practice of medicine But there are certain drawbacks and shortcomings in quinine which have led to attempts to use other drugs in conjunction with quinine or all too frequently, in place of it These drugs have been discussed by Bass

Of these drugs plasmochin has received much attention since it was announced in 1926 Apparently one of the main ideas back of the preparation of plasmochin was to prepare quinine synthetically on account of the high price of quinine

The early reports regarding plasmochin in malaria were enthusiastic in reporting that plasmochin alone in tertian and quartan malaria acts as well as does quinine, and that relapse is less frequent than when quinine alone is used In subtertian malaria Muhlens advised the combination of quinine with plasmochin since quinine seems to have a better action on the schizonts while plasmochin prevents the formation of gametocytes and destroys them when formed

Cordes compared the action of plasmochin with that of quinine alone on the gametocytes in 72 successive cases of subtertian malaria giving the odd numbered cases 2 grams of quinine sulphate daily in 2 doses and the even numbered cases 1 gram of quinine sulphate and 80 mg of plasmochin daily

Of the 36 cases on quinine alone 17 developed crescents during treatment 4 were negative for crescents after 3 4 5 and 6 days respectively while 13 cases were still positive for crescents on the eighth day and later

Of the 36 cases on quinine and plasmochin 23 developed crescents during treatment in 6 cases crescents were found only once or twice in 16 cases the crescents disappeared in 3 to 7 days and in one case crescents were still present after 8 days of treatment

While Cordes short series does not confirm Muhlens finding that plasmochin prevents the formation of gametocytes it does demonstrate that plasmochin has a marked effect on the gametocytes and that they disappeared from the peripheral blood in the majority of cases in 3 to 7 days Gametocytes were still present in the peripheral blood in the majority of his quinine cases on the eighth day

While various workers were studying the effects of plasmochin on crescents as shown in stained smears of blood, Burke conceived the idea of studying the effects of the drug on crescents by experimentally testing its effect on the infectiousness of crescents for mosquitoes Following out this idea, Barber Komp and Naumann carried out a series of experiments in the Panama Division of the United Fruit Company This work showed that small doses of plasmochin rendered crescents non infectious for mosquitoes even though the crescents were still alive and able to flagellate in the blood in one case of an 11 year old boy, weighing 59 pounds, a single dose of 5 mg of plasmochin rendered the gametocytes non infectious for mosquitoes

This rather startling finding called for confirmation in some other locality and, at Deeks request, Whitmore, Roberts and Jantzen repeated this work in Honduras

These results confirm the work of Barber, Komp and Naumann to the extent that we never saw a mosquito infected after a single dose of 20 mg of plasmochin to an adult, but 10 mg of plasmochin was not enough to prevent infection of a small percentage of mosquitoes The results on intermediate doses were not satisfactory either on account of error in giving the dose or on account of failure to infect mosquitoes before plasmochin was given

The variation in the infectiousness of the gametocytes for mosquitoes is interesting and is discussed in our report

DISCUSSION

In subtertian malaria clinical experience has borne out Muhlens' early finding that quinine acts better on the schizonts than does plasmochin and plasmochin alone is not used in the treatment of subtertian malaria

Many workers are of the opinion that plasmochin combined with quinine hastens the cure of malaria especially in chronic cases but there is no experimental evidence on this point, and in the nature of things it will be difficult to obtain such evidence

Cordes' parallel series confirms Muhlens finding that plasmochin hastens the disappearance of crescents from the peripheral blood but it does not indicate that plasmochin prevents the formation of crescents

The experimental work in Panama and Honduras indicates that plasmochin has a marked effect in rendering the crescents non infectious for mosquitoes even though the crescents continue to circulate in the blood for 3 to 5 days We made wet fixed smears from our cases in Honduras and the study of the crescents in these preparations will be reported later

How are we to explain this marked action of

such small doses of plasmochin? It is hardly possible that so small a dose of a drug would have so marked an effect in itself especially when it has little effect on the schizonts Of course all of our cases were receiving quinine as no one will try to treat subtertian malaria without quinine I have no doubt that the malarial parasite is intracellular as Whitmore showed for *P relictum* in 1918 and as Ratcliffe showed for *P vivax* Is it possible that the plasmochin renders the red cells more permeable to the quinine thus enabling it to come into contact with the contained parasite in greater concentration? Work on this point is now under way Or does the plasmochin render the crescent itself more permeable or more susceptible to quinine in this less active vegetative state? If this were the case it might be the explanation of the clinical experience that plasmochin aids quinine in clearing up obstinate and chronic cases of subtertian malaria This brings up the question of adjuvants which can not be discussed here

It has been suggested that plasmochin may aid in preventing relapse possibly through its action on the gametocytes Ross Bignami Thomson and others opposed Grassi and Schaudinn s parthenogenesis or reversion theory of relapse and held that the continuation of the asexual cycle was necessary for latent malaria and relapse In 1918 Whitmore pointed out that the persistence of the asexual cycle was necessary to the persistence of gametocytes for longer than two months (owing to the short life of the red cell) and in bird malaria found schizonts to be present in the blood of infected canaries throughout life thus making it unnecessary for the gametocytes to take any part in relapse Simons (1919) found only schizonts in all stages of schizogony in 95 92 per cent of all of his cases of latent malaria in which he could find parasites at all Ziemann and Simon saw gametocytes and schizonts in spleen puncture material with no evidence of parthenogenesis or reversion of gametocytes to schizonts Ziemann in searching for parthenogenesis found only examples that could just as readily be interpreted as infections of a red cell with schizonts and gametocytes or as abnormal sporulation and Schuffner (1928) comes to the conclusion that the appearances of parthenogenesis are multiple infections of red cells

The frequent finding of sporulating forms in the spleen and liver of persons dead of some other disease than malaria the finding of sporulators in placental blood of women who do not have malaria at the time of delivery the not infrequent transmission of malaria by blood transfusion from a donor who has lived in a malarious country but may not have had malaria coupled with Thayer s failure to transmit malaria by injection of blood known to contain crescents but which as far as could be determined did not contain schizonts all of this speaks for *a continued schizogony which is back of relapse* and with which the gametocytes have nothing to do The impossibility of transmitting Hemoproteus (where only gametocytes are in the peripheral blood) by injection of infected blood speaks strongly against the gametocytes being able to undergo any reversion to schizonts and *starting the asexual cycle*

All of this means that the schizonts are responsible for latent malaria and relapse and that the gametocytes have nothing to do with it

But we have known from the beginning of the work with plasmochin that it does not act as well on the schizonts as does quinine and it is accepted that quinine is the drug to use against the schizonts This means that the action of plasmochin on the gametocytes has nothing to do with preventing relapse and that quinine is the drug for preventing relapse the use of the standard treatment of malaria for this purpose is perfectly sound The only place that plasmochin can have here is as an aid to quinine in stopping the asexual cycle as has been observed by a number of workers

Plasmochin has been used in the treatment of blackwater fever with the idea of avoiding the bad effect that quinine is reputed to have on the red cells in some cases of that condition But we know that when malarial parasites are found in blackwater fever plasmochin will not have any effect on the schizonts and the gametocytes on which it has some action (possibly only in the presence of quinine) play no part in blackwater fever So it is difficult to see where plasmochin is indicated in blackwater fever Work is under way on the use of other alkaloids of cinchona in this condition

Plasmochin has been suggested for use in prophylaxis of malaria in place of quinine probably on account of the association of quinine with hemoglobinuria Very recently I have been consulted regarding the advisability of using plasmochin in place of quinine for malaria prophylaxis by a person going on an extensive trip in back of beyond in the Orient

After what has been said regarding the lack

of action on schizonts by plasmochin, it is evident that under no conditions should plasmochin be used in individual prophylaxis against malaria. Quinine is the only drug to be considered here.

What then is the place for plasmochin? All experimental work indicates that the place of plasmochin is in rendering gametocytes non-infectious for mosquitoes. With experimental work indicating that small doses of plasmochin very promptly render crescents non-infectious for mosquitoes (some of our feedings were as soon as 11 hours after the single dose of plasmochin) it does not seem necessary to give the drug in large doses in courses of several consecutive days. The sheet anchor in malaria is quinine, 30 grains daily until symptoms stop (2 to 3 days), then 15 grains daily to complete the week, then 10 grains daily for not less than two weeks. The patient is given 20 mg. of plasmochin a day or two before discharge from the hospital and this dose is repeated every 3 or 4 days during the follow-up period. This is in general the method now in use in the United Fruit Company divisions.

SUMMARY

In spite of our long and varied knowledge of the various factors associated with malaria and its control, the disease is one of the greatest problems of tropical and subtropical countries.

Quinine is the one outstanding drug in the treatment and control of malaria, and difficulties in giving the drug in the dosage necessary for the cure of the case is the main difficulty in its satisfactory use today. Quinine is the only drug to be considered in prophylaxis, treatment and prevention of relapse in malaria, and this includes the stopping of the production of gametocytes.

Plasmochin may have some adjuvant action to quinine in the treatment of chronic and obstinate malaria, but experimental work shows the particular field of plasmochin to be as an adjuvant to quinine in rendering gametocytes non-infectious for mosquitoes and in hastening the disappearance of gametocytes from the peripheral blood. This makes it possible to return patients to duty without waiting for their blood to be free of gametocytes, a matter of great importance in the control of malaria in industrial organizations.

Discussion follows paper of Dr. Meleney, page 423.

*MOSQUITO PROOFING AND TREATMENT IN THE CONTROL OF MALARIA ON A PLANTATION**

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The purpose of this report is to record the results obtained to date in an attempt to control malaria on a plantation in West Tennessee. The plantation, which is known as the Henning Farm, is composed of fourteen square miles of Mississippi River bottom land in Lauderdale County. The crops are principally cotton and corn. The farm tenants all live within an area of two and a half square miles near the eastern border of the farm adjacent to the hilly portion of the County (*Map 1*). There are sixty houses besides that of the farm manager. Fifty-nine of the tenant houses are occupied, ten by white and forty-nine by colored families. The total population is 262, 46 white and 216 colored.

The houses have been classified as to their structural condition with reference to the amount of work necessary to make them mosquito-proof.† The system of classifying the houses is as follows:

Class 1 is a house that has:

- (a) Weatherboard or clapboard exterior,
- (b) Satisfactory roof,
- (c) Walls and ceilings of tongue and groove boards or plastered,
- (d) All floors tongue and groove,
- (e) Doors and window frames in good condition for screening.

Class 2 is a house that has not more than two of the above items defective.

Class 3 is a house that has more than two

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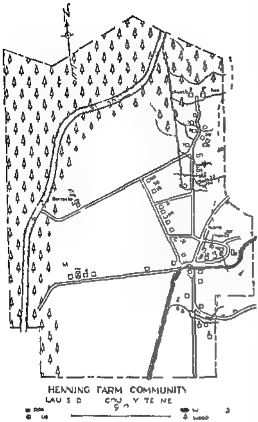
From the Tennessee State Department of Public Health, the Department of Preventive Medicine and Public Health, Vanderbilt University, and the Lauderdale County Health Unit.

†The classification as well as the rating schedule for mosquito proofing, which is to be described later, was devised in collaboration with Mr. H. R. Fullerton, Sanitary Engineer of the State Health Department, and he personally classified and rated the houses on the Henning Farm.



and not more than four of the above items defective

Class 4 is a house where mosquito proofing is not feasible

According to this classification four houses were placed in Class 1 thirteen in Class 2 forty two in Class 3 and none in Class 4 This indicates that the structural condition of most of the houses is bad but that it is physically possible to make them all mosquito proof

Since working conditions on the farm are good there has been very little change in the population group since our study began in 1928 The farm contains many potential Anopheles breeding places including a slough with adjacent marshy ground a creek with numerous side pools and several brooks which run down from the hills and some of which spread out into marshes or small ponds In August 1928 a survey[1] showed that 45 per cent of the inhabitants gave histories of chills during the preceding year and that 22 per cent had malaria parasites in the blood on a single thick drop examination Sixty five per cent of the houses contained *A quadrimaculatus* mosquitoes with an average of seven per positive house The farm manager stated that the loss of time from malaria during previous cotton picking seasons had been a serious handicap

MOSQUITO PROOFING OF HOUSES

During the summer of 1928 the owners of the farm agreed to pay for the mosquito proofing of the houses Screen doors of the design recommended by the United States Public Health Service were made by the Lake County Health Department and screening was done under the supervision of the sanitary inspector of the Lauderdale County Health Unit In the spring of 1929 the tenants were furnished with used cotton sample wrapping paper and by the end of the summer all of the houses had been fairly satisfactorily papered by the tenants themselves During the same period all floor cracks were covered with strips of sheet iron It was found at this time that many of the screen doors already had been damaged[2] The chief defect was a kicking-out of the screen at the bottom of the door To remedy this an additional four inch wooden strip was inserted above the bottom member of the door In the spring of 1930 baskets of mothballs were placed in all the chimneys and the unused stove flues were closed

In October 1930 a survey of the houses was made to determine their condition in regard to mosquito proofing Deductions for defects were made by means of a scale of rating somewhat similar to that used in the rating of dairies Defects were recorded in screen doors and window screens papering of rooms and closing of floor cracks The maximum deductions for these items were as follows doors 35 per cent windows 25 per cent papering 25 per cent floors 10 per cent and chimneys and flues 5 per cent The survey showed that the houses were about 92 per cent mosquito proof *Table 1* shows the rating of the houses according to percentage groups This table shows that four of the houses were entirely mosquito proof Forty two per cent were rated 95 or above, and 80 per cent were rated 90 or above In analyzing the survey it was found that 40 of the houses had defects in the doors most of which could be easily

Table I

MOSQUITO PROOF RATING OF HOUSES ON THE HENNING FARM OCTOBER 1930

Clas of Hou e	Rating by Percentage Groups							
	100	95 99	90 94	5 89	80 84	5 9	0 4	Totals
1		4						4
—	3	5	3	1	1			13
3	1	1	19	5	1	3	1	4
Totals	4	21	22	6		3	1	59
Pe cent f total	6 8	3 6	3	10 2	3 4	5 1	1 7	100 1

remedied 10 had similar defects in windows, 42 had defects in papering and 14 had defects in floors It is evident therefore that although nearly all of the houses had defects in mosquito proofing they were of minor importance It is also evident that the screens are still in fair condition after a period of two years

The degree to which mosquitoes are excluded from the houses even with this protection depends mainly on the manner in which the people use their screen doors In a survey of the houses for *A quadrimaculatus* on September 12, 1930, a total of fifteen mosquitoes were found distributed among ten houses Although this is a marked contrast to the condition in August 1928 when 35 houses were found to harbor 245 mosquitoes the drought this year has so reduced the Anopheles breeding places that it is not possible to state how much of this reduction is due to mosquito-proofing

TREATMENT OF MALARIA

Following the first survey of the farm in August 1928 a cour e of treatment with quinine covering six weeks was administered to a large number of tenants This was done by visiting the farm once a week and leaving with each family enough quinine to permit adults to take 15 grains on two successive days a week and children proportionately smaller doses As a result the farm manager reported that practically no labor time was lost during the cotton picking season

During the summer of 1929, quinine was again distributed to the tenants at intervals of two or three weeks and they were urged to take either ten grains a day or fifteen grains on two successive days each week Again, practically no labor time was lost during the cotton picking season A blood survey however made in November and December 1929 showed 19 per cent positive which was only 3 per cent lower than the per cent positive before the malaria control work was started in 1928 The three factors mainly responsible for failure to reduce the blood incidence were probably (1) the ineffectiveness of the treatment (2) the fact that the mosquito proofing of many of the houses was not completed until late in the summer of 1929 and (3) the failure of the tenants to use intelligently what protection they po sessed It is impossible to estimate the relative importance of these factors

In planning the malaria control work on this farm for 1930, it was felt that very little more could be done in the way of mosquito proofing except to install naphthalene in the chimneys and to close the unused stove flues These measures were taken in the pring It seemed desirable to eliminate as far as possible relapses of old malarial infections as a factor in the continuance of a high blood index Since the previous treatment had not been well controlled, it was decided to conduct an intensive treatment campaign during the spring of 1930 A special nurse was employed to administer personally each dose of medicine It was decided to use plasmochin and quinine together since reports of other observers indicated that the course of treatment might thereby be shortened and that fewer relapses might be expected than with quinine alone[3 4] The full course of treatment lasted five weeks and four days with an interval of one week at the end of the first three weeks Quinine sulphate was administered in capsules daily throughout the treatment period Adults were given 10 grains a day and children proportionately smaller doses In addition tablets of plain plasmochin* were administered on the first four days of each week, making a total of 24 doses given in six periods of four days each Since we were anxious to avoid reactions to this drug the dosage for the first two weeks was limited to 2 centigrams a day for adults and 1

The pla mo hin fo this work was kindly supplied by the Winthr Ch mical Company

centigram to children between five and twelve years of age Children under five years were not treated at this time During the third, fourth fifth and sixth weeks 4 centigrams a day for the first four days of each week were ad ministered to adults and proportionately smaller doses to children down to two years of age The nurse administered 97 per cent of the scheduled do es of plasmochin and 95 per cent of the scheduled doses of quinine No toxic re actions ascribable to plasmochin were noted, al though they were carefully looked for

A blood survey was made before treatment was started another after the first three weeks of treatment a third at the end of the treat ment and a fourth four and a half months later *Table 2* shows the results of these surveys The

Table II
BLOOD SURVEYS HENNING FARM 1930

	Total Specimen	Positive Number	Positive Per Cent
First survey April 1	30	31	13 5
Second survey May 5 7	6	12	5 1
Third Survey Ju 4	3	3	1 3
Fourth survey October 14 16	0	12	5 5

selection of persons to be treated was made after the first survey In this survey, 25 per cent of the tenants gave a history of having had chills during 1929 and 13 5 per cent showed ma laria parasites in the thick drop preparations which were taken Sixty persons were first se lected for treatment At the end of the first three weeks treatment was suspended for one week in order to obtain the second blood sur vey In this survey 12 persons or 5 1 per cent showed parasites in the blood * Ten persons re fused further treatment but 23 others were started, including nine who had first been posi tive on the second survey and fourteen others who requested treatment

At the end of the second treatment period the third blood survey revealed only three positives an incidence of 1 3 per cent One of these was a colored girl who had been given the full course of treatment because of a history of ma laria Her blood had been negative on both the first and second survey but on the third survey a few small ring forms were found the species of which was impossible to determine The sec ond positive was a colored boy whose blood had shown rings and crescents on the first sur vey Although he received the full course of treatment his blood showed a few rings on both the second and third survey The third posi tive was a colored woman who had not been treated Her blood had been negative on both previous surveys but showed *P vivax* on the third No further attention was paid to the plantation until the week of October 14 when the fourth survey for the year was made Twelve persons (5 5 per cent) were found to have parasites in their blood

Table 3 gives a summary of the results in those who were treated A satisfactory imme diate result was of course to be expected even if quinine had been used alone However, a point of interest which might be attributed to the aid of plasmochin is that eight persons showed crescents on the first survey, but none showed crescents on either the second or third survey

The fourth survey showed that among those who had been treated in the spring campaign 11 (13 3 per cent) had had symptoms which might have been due to malaria since the treat

Table III
RESULTS OF PLASMOCHIN QUININE TREATMENT HENNING FARM 1930

Treatment Taken	Number Treated	Result of Blood Examination: First Survey April 1 5, Positive	Negative	Not Exam	Second Survey May 5 7, Positive	Negative	Third Survey J 3 4, Positive	Negative	Not Exam	Fourth Survey October 14 16, Positive	Negative	Not Exam
First Course only	10	5	5	0	0	10	0	9	1	5	4	1
Second Course only	23	0	0	3	9	14	0	3	0	1	[illegible]	[illegible]
Both Courses	50	5	5	0	3	47	2	47	1	1	45	4
Total	[illegible]	30	50	3	12	1	2	79	2	7	68	8

This e was negative on both the first and second survey
This case showed rings (species undetermined) on both the first and second survey but refused exam ination on the third.

ment campaign and 7 (8 4 per cent) had para sites in the blood *Table 3* shows that, of the ten persons who had received only the first half of the course five (50 per cent) were posi tive in this fourth survey while of the twenty three who had received only the second half, one (4 3 per cent) was positive The first half of the treatment course had provided a little more quinine than the second, but had provided only two thirds as much plasmochin as the second because of the smaller doses during the first two weeks Although the series of cases is too small to warrant a definite conclusion the results sug gest that the first half of the treatment course was less effective than the second half and that the higher dosage of plasmochin may have been responsible for this In the last blood survey no more than a few parasites were found in any specimen Only two specimens showed para sites that could be identified as *P vivax* three showed crescents, one showed rings characteristic of *P falciparum* and the other six showed only a few rings the species of which could not be determined Our experience in other surveys makes us believe that most of these ring forms were probably *P falciparum* It appears there fore that this parasite was more difficult to eradicate from this group of people by the method employed than was *P vivax* The pic ture at the present time is that of an endemic malaria which might be termed residual in a group with a relatively high resistance to the infection

As a control for the observations on this plantation we have the results of surveys made in March and September 1930, in the Rich wood school in the bottom land of Dyer County where no malaria control work was done and in the rural schools of Lake County which is all bottom land *Table 4* shows a comparison of these results with the results of the pretreat ment survey in April and the last survey in October on the Henning Farm Although the dates of the fall surveys are not exactly con temporary we believe that they are close enough for comparison It will be seen that the fall survey on the Henning Farm showed a decrease of about 60 per cent in the blood index while those in the Richwood school and the Lake County schools showed no significant change The summer drought of 1930 was probably re sponsible for the absence of the usual autumn increase in the index in the unprotected com munities (Richwood and Lake County), and may have accentuated the decrease on the Hen ning Farm But it did not produce a signifi cant decrease in the unprotected communities like that seen on the Henning Farm We be lieve, therefore, that we are justified in assum ing that the decrease on the Henning Farm was due mainly to the treatment campaign

Table IV

COMPARISON OF SPRING AND FALL BLOOD SURVEYS ON THE HENNING FARM WITH THOSE IN RICHWOOD SCHOOL IN DYER COUNTY AND IN THE SCHOOLS OF LAKE COUNTY

	Spring Survey		Fall Survey	
	Date Week of	Per Cent Positive	Date Week of	Per Cent Positive
Henning Farm	March 1	13 5	Oct 13	5 5
Richwood School Dyer County	March 17	18 9	Aug 5	17
Schools Lake County	March 17	11 5	Sept 1	11 6

COMMENT

We realize that the type of treatment cam paign used in this study could be employed only in small groups of people and under the most favorable conditions Our results suggest, how ever that in such groups the use of plasmochin in conjunction with quinine may produce better results than quinine alone The method ap pears to be applicable where a rapid reduction in malaria is desired in conjunction with the em ployment of other malaria control measures

The drought of 1930 undoubtedly contributed to the clarity of the result produced by the treatment campaign, since transmission of ma laria was reduced, and fewer new infections were possible It is probable that most, if not all of the positives in the October survey repre sented relapse of old infections

In measuring the effectiveness of mosquito proofing the drought was a hindrance rather than a help, since the finding of only a few *A quadrimaculatus* in the houses in September may have been due mainly to their general scarcity This is indicated by the fact that in the Rich wood community in Dyer County, where there were only a few screened houses a survey early in September showed that only six houses out of thirty two contained mosquitoes with no more than two in any one house

It is planned to conduct a campaign of edu cation on malaria on the Henning Farm during the coming winter and to keep the mosquito-proofing of the houses in as good condition as possible throughout the mosquito season of 1931 In the autumn another survey will be made for the purpose of obtaining further information as

to the efficacy of the measures used in prevent ing malarial infections

SUMMARY

(1) An attempt to control malaria on a plantation in West Tennessee by mosquito-proofing the houses and by treatment with quinine and plasmochin is described

(2) Although most of the houses are of poor construction a survey at the end of two years work indicates that the hou es are about 92 per cent mosquito proof

(3) Insufficiently supervised treatment with quinine during 1928 and 1929 resulted in only a slight reduction of the blood index of malaria

(4) A closely supervised treatment campaign in April and May 1930 covering five weeks and four days and using quinine and plasmo chin produced an immediate reduction in the *blood* index *from 13 5 per cent to 1 3* per cent Four and a half months later (October 1930) the blood index had again risen to 5 5 per cent No individual in the last survey showed more than a few para ites in the blood and most of the positives showed *P falciparum*

(5) Both the immediate and late results of the treatment campaign suggest that plasmochin may have increased the effectiveness of the treatment both in freeing the blood of gameto cytes and in preventing relapses

(6) Too short a time has elapsed to make it possible to judge as to the efficacy of the meas ures used in permanently controlling malaria on this plantation The drought of 1930 probably contributed to the temporary reduction in the incidence of malaria throughout the entire west ern border of Tennessee

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DISCUSSION (*Abstract*)

P pers of Dr Whitmore and Dr Meleney

Dr H C Cla k Panama City Panama—There is a grow ng tendency in some quarters t discard quin ne for the new d ug plasmochin This n my opinion is a very serious mist ke After all the actual control of gamete carriers depends on the destruction of the asexual cycle and quinine is the best drug we have for that even though it does fail in a certain propor tion of the cas s treated Recent research work indi cates that plasmoch n s of value in devitalizing gametes and p eventing mo qu to infection More extensive e search must be done to measure the real value of this feature

It is difficult to harmonize the malar a para ite index in a community with the mosquito index of infection Th s s part cularly true when one stops to con der the type of human carrier that is qui ed for success ful mo quito feed ng experiment I am following eight rural villages without med cal or sanitary ca e in the ba n of the Chagres R ver and we do monthly blood film surveys of about 1 000 people About one fourth of these are pos t ve for malarial para ites yet we find only three or four people amon these po itives who meet the requ ements at the time for good cases on wh ch to feed mosquitoes One s led to believe that new malarial infect ons form but a small part of the ommunity index and that most of the incidence s due to chron c case and relapse I have seen several men le ve the tropics for non m la ial reg on in the temperate zone to e cape what they considered renewals of *fection who di covered after long stays in such* place that th r tr ble wa relapse rather than new inf ct on I have one friend who went to New York and did not lea e the ty f r two years yet he had four attack (relap es) of malaria notw th tanding the fact that he was on orou treatment du each attack Such experiences are di cou ag g yet we can feel as ured th t qu nine by far the best f end we have to check if not eradicate the asexual cycle Plasm hin as far as experience po nts at esent is s mply reserve ass sta e n the control of gamete car ri rs in those case where qui n f ls to eradicate the asexual cycle I have seen one c se of e tivo autumnal mala ial feve f llowed by an att ck of blackwater fever in an individual who as u ing plas moch n a a p phylactic mea ure during a protracted stay in a commun ty with a hi h malarial index These drug (quinine and pla mo hin) are u eful in supp ess g malarial activity in ru al reg ons where one de ires to al ge labor days to forward the ork of commercial gan at operating in large m la ial a eas but the actual erad cat on of i fections s d fficult and the be t p eventive measure is to pre ent the bite from fected m squitoe This means the proper use of mosquito proofed h u e in regions where t is financi lly impos ible to control m sq ito b ed ing It is e tremely difficult to educate the labor class in the proper care and use of screened quarters How ever in the course of a few yea s even w th the in different use of screened sleep ng quarters by such labor un ts h ws a plea ing drop in the incidence of ma laria

Dr L W Hackett Rome Italy—I can conf rm Dr Wh tmore s result with two cent g ams of quin ne but I do not share his enthu iasm for plasmochin Our reliance for the p evention of relapse must be on qui nine

We saw interesting results in the screening of quar ters in Belgi The houses w re very well screened and m squ to proofed and an inspector was engaged to go f om room to room every morning killing all mos quitoes There had been 230 cases of malaria there the year before and that year after screening they had 8 ca es

Dr J N Baker Montgomery Ala—Screening is but one of the physical practical methods to be employed in the protection of man against those diseases brought to him by an intermediary such as the fly and mosquito and to my mind one of the greatest benefits accruing from a campaign of screening lies in its educational value A host of earnest workers are today striving to unravel the mysteries of the cause of cancer Does any one make so bold as to assert its secrets will not be unearthed and that we here present may not live to know its cause and may we hope its cure? May we not hope the same in regard to malaria? The practical worker needs to grasp and utilize every spark which falls from the anvil of science I have the feeling that in plasmochin science has given a something which does strengthen and complement quinine therapy It no doubt is not the last word but it is a trail struck in the right direction Let us then as practical workers until something better is offered test and retest this agency in the crucible of clinical experience until we either know its worth or its worthlessness. In Alabama we have been making some practical tests in the use of this drug in several malarious areas and I am going to ask *Dr Gill our epidemiologist* who has had supervision of this work to tell you quite briefly of this work

Dr D G Gill Montgomery Ala—Dr Baker refers to a small experiment we have been carrying on this year in Alabama as to the effect of plasmochin on the incidence of malaria

We have chosen two areas each of approximately one thousand population These areas have been divided and one half of each used as a control The experiment in brief consisted of a preliminary survey including history and blood surveys of the whole area Then beginning with the first of June and continuing until the first of November the people in the experimental area were given one tablet of plasmochin compound once a week No other control measures were adopted Careful histories have been kept of all areas and a second blood survey has just been completed

No conclusion can be drawn as yet but the opinion of our field workers is that there has been less malaria in the demonstration areas than in the control areas The work will of necessity need to be carried on over several years before we arrive at any conclusion

Plasmochin should be given a thorough test and I feel that there are possibilities of its being an efficient weapon in malaria control

Dr Paul Eaton Jacksonville Fla—I came away from Miami last year with the idea that if I went into a malarial district I should take quinine for myself and give the other fellow plasmochin in other words that *the only value of* plasmochin was in preventing the infection of mosquitoes What I have heard today rather upsets me Is it being found that plasmochin is of use to the individual as well as to the community? I wish somebody would set me right about this

Dr K F Maxcy University Va—As I understand the present status of knowledge on the subject plasmochin given in doses of one to two centigrams over a period of three to four days will hasten the disappearance of gametocytes from the blood This disappearance will be permanent if at the same time the parasite is completely destroyed in the patient's body by the concurrent treatment with quinine and the action of the defense mechanism of the host If on the other hand the parasites are still present in the body it is only a question of time before a new crop of gametocytes makes its appearance in the peripheral blood. While therefore the use of plasmochin compound may reduce the number of gametocyte carriers its effect is only partial and more or less temporary It is possible that its use in the cooler climates of the United States where the period of transmission is relatively short may be much more effective than in tropical climates

Dr H C Clark Panama City Panama—We are trying to emphasize control of the production of gametocytes As long as sporulation goes on new gametocytes are produced

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THE ROLE OF THE PHYSICIAN AND THE VALUE OF THE THICK FILM IN THE CONTROL OF MALARIA*

By WILLIAM KRAUSS M D
Bolivar Tenn

An attempt will be made in this article to sell' the general practitioner on the thick film in the diagnosis of malaria for the sake of better diagnosis and malaria control

Malaria is essentially a chronic disease A few doses of quinine will always stop the fever A subsequent fever may be a relapse a reinfection or something else entirely Random dosing because of a previous history of malaria will not get us anywhere The treatment of estivo-autumnal malaria differs from that of benign tertian especially as regards collateral and after treatment A few doses of plasmochin stop the infectivity of gametes but the problem of cure remains Quinine by itself does not cure malaria Some persons get well with little or no treatment others require much more and still others for example the superinfected exhausted *soldiers in the late War* are well nigh incurable Their natural defenses have broken down

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Neither the patient nor the plasmodium becomes quinine fast '

These are matters for the judgment of the trained physician We mu t understand the normal mechanism of defense the pharmacology of quinine the mode of absorption routes and rate of elimination storage and destruction in the body and effect of cathartics

Great quantities of quinine are consumed under the mistaken idea that almost any fever chilly sensation or indisposition is due to malaria As to the absolute need or advantage of a blood examination I regret to say that there are still very many who will differ with me There are old practitioners who have not acquired skill in making smears These men still defend the therapeutic test But that is what we get in chiropractic and Christian Science the proof of the pudding For years I have been convincing chronic quinine takers that they had no malarial infection

On the other hand a laboratory diagnosis by the health department means correct treatment by the physician inspection protection against spread and follow up ervice to prevent recurrence With a live local lay or auxiliary health organization behind him the physician can convince his patient that this is real economy No such service comes wrapped up with a patent medicine the dose of which is usually just enough to suppress symptoms

It is urged that smear diagno is misses too many positives and that reports are too tardy to be of service This unreliability is the fault of the physician the laboratory or both or due to the chance of missing a positive smear Many persons now examining smears are not competent Only well trained keen-eyed conscientious microscopists can give satisfaction but we have to reach perfection by degrees and the physician can help The responsibility for the patient rests with the physician who must use his best judgment He can take a chance on a negative smear in the spring time but not in the season of pernicious malaria Even here he is not through with the laboratory if he has begun treatment The first doses often flush parasites out

The pyretogenic limit is variously given at from 20 to 50 plasmodia per cu mm one to 250 000 red cells. There is a chance for false positives as well as negatives due to bad laboratory work The very small slender rings of the subtertian are easily overlooked if (a) the smear is bad (b) if it is improperly stained (c) if a daylite lamp is used Monochromatic light misses fine rings in superimposed cells or obscures the chromatin which is essential for correct diagnosis A binocular microscope reduces eye strain A keen-eyed worker can cover 100 000 cells in 15 minutes twenty minutes should be the least for an average A thick film worker can do the same work in five minutes If smears are positive one should not miss more than 3 per cent

Method —Slides and point to be punctured must be cleaned the former scrupulously with pure methyl or ethyl alcohol Use no denatured mixtures nor cambric nor hypodermic needle If you drive a small Hagedorn needle into the stopper of the alcohol bottle you will always find it and get a better smear A small crystal of sodium carbonate will prevent rust.

Make a puncture on the dorsum of the finger or the tip of the ear Grease and sweat pressed out from the palmar surface spoil the smear The blood must flow freely enough with the least pressure

Pre s out and wipe off the first drop Grasp the slide by the edges and at a point 3/4 inch from the proximal end take off a drop 1/4 inch in diameter and about half as thick when on the slide Wipe off for a fresh drop and place this an inch from the first and a small drop near the end to use as a label This is to be spread transversely With the corner of another slide spread the other two to the size of a one cent piece by describing centrifugal circles Perfect evenness is not necessary (Schilling method)

Also take a regular thin smear For index work one thick and one thin can go on the same slide For individual smears this is not practical The mistake usually made is to take too much blood and either pile it up or run it over the edge The larger infected cells are often found at the edges and end of the mear Laboratories usually give the technic for thins

On cold or damp days warm the slide before smearing Cushion the air-dried slides to prevent jarring The thicks may peel off with rough handling

The time for obtaining the smear is when you reach the patient Directions to take before the chill are absurd except for laboratory study

Its time of appearance is problematical, the best time is after the chill and the earlier the diagnosis the better. There may be time to wait for a laboratory report, in which case a laxative may be given in the interim. An initial dose of quinine (if properly indicated) may be provocative of a positive smear.

"What is the use of examining the blood after quinine has been given or when we cannot await a report?" one is asked.

Because your patient is entitled to a diagnosis and the health department needs the information. This is the real reason for a free examination.

In the hospital we withhold quinine until the smear is positive unless the case is obviously pernicious. In private practice this is not always a safe plan.

What are the chances of a positive report?

Of 657 consecutive cases of clinical malaria which I have checked over 54 or slightly less than 9 per cent had negative smears throughout. Eighty one per cent showed parasites on the first examination. Approximately half of these had taken quinine or chill tonic.

SUMMARY

The treatment of malaria is the function of the practicing physician. The examination of smears and sanitary control belong to the health department. The fostering of interest in malaria belongs to the whole community.

The advantages of the thick film and a technic for best obtaining malaria smears are presented.

Greater interest in proper diagnosis is urged.

References for the study of recent advances in the treatment of malaria are given.

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RECENT DEVELOPMENTS IN THE CONTROL OF MALARIA IN ITALY*

By L W HACKETT, M D, DR P H,
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Malaria has always been, and still is Italy's chief health problem.† This is the barrier which prevents the free movement of dense northern agricultural populations towards the rich deltas and sparsely inhabited plains of Sardinia and the South. This it is which until recently has kept Rome itself from exploiting the well watered and fertile "campagna" at its gates compelling it to obtain its milk from Milan and its vegetables from Naples. In fact the long history of the attempt to rid the Tiber delta of malaria with its dismal failures and impressive victories is full of lessons for the malariologist.

Organized warfare on malaria did not await the discoveries of Ross and Grassi. From the earliest times malaria has been associated by Romans and Italians with swamps and standing water, and therefore drainage has had a sanitary as well as an economic aim in every epoch. Large scale operations are associated with the names of emperors and popes, of local rulers during the Renaissance and of kings and prime ministers of United Italy since the Risorgimento. So called consortiums or associations of landowners for the financing and execution of drainage schemes (corresponding to our "drainage districts") have existed in the Po Valley since the Fourteenth Century and over a hundred years ago the grand dukes of Tuscany initiated a colossal project which is still going forward and will require another twenty five years to complete. All in all the Italians have wrested and withheld more land from the domination of the waters than the Dutch. They have given a name "bonification" to land reclamation which has both hygienic and agricultural objectives, a name now universally adopted.

The financing of such projects is made possible by the high value of well-drained agricultural land. The Government usually offers 75 per cent of the total cost of reclamation giving a promise to pay in fifty annual installments covered after the first decade by the taxes on

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†From the Malaria Experiment Station Rome maintained by the Rockefeller Foundation in collaboration with the Italian National Health D

increased production Owners raise the remaining 25 per cent by mortgaging the land the value of which will rise from $4 00 to $80 00 or even $200 00 an acre as the water is drained off

You will note that the soundness of the financial operations depends on the pressure of the agricultural population on the land leading to an immediate intensive cultivation of drained areas and to a market for produce at prices which will pay interest on the capital investment These conditions have so far been present in Italy You will remember that a population of *43 millions subsists on an area about the size* of California only one third of which is susceptible of intensive cultivation The absence of these conditions prevents similar drainage and colonization activities in the United States or renders them unprofitable

If however we inquire what the effect has been upon malaria we must admit that these projects have not been uniformly successful and only slowly effectual at best The most striking successful and permanent form of bonification as well as the soundest from the point of view of malaria control is the filling of bottom land or coastal lagoons by sedimentation of the flood waters of rivers from the Appennines the *disintegrating central mountain chain of Italy* waters containing at times 16 per cent of suspended material by volume Great units of 10 000 or more acres each are diked around to the desired level and the rivers turned into them at flood When the great tank is filled the water is allowed to stand for 48 hours and then led off over a spillway to make room for a new charge In a good rainy season with six or eight floods a deposit of silt more than a foot deep can be obtained over the whole surface and in fifty to a hundred years the level of a vast area can be raised from a metre or so below sea level to a metre or so above so that natural gravity drainage will eventually do away with the necessity for pumps Such a process of warping or filling on a large scale by the sedimentation of natural waters is going on both in the Maremma or coastal area of Tuscany and near Ravenna, but the area is a relatively small one Rivers from the Alps do not contain enough suspended water and the Po Valley and delta depend on pumps for drainage

On the lowlands with their network of sluggish canals and ditches it has taken from sixty to a hundred years for malaria to disappear as a rule and in some important cases malaria has not even been affected the land has not been occupied and the project has been a failure, economically agriculturally and hygienically The reason for this is twofold On the one hand in the northern areas where the relative absence of estivo autumnal malaria allows immigration to begin and intensive agriculture to proceed on the newly drained and rich soil the attention of *A maculipennis* (the sole carrier) becomes gradually directed to the numerous and well stabled domestic animals which soon become an important factor of agricultural economy The association of this anopheline with man virtually *ceases (as happened in Tuscany years ago)* and malaria automatically disappears We then have the situation known as Anophelism without malaria On the other hand on the Tiber delta pumping lowers the water table to such a depth that in the long dry season intensive agriculture becomes impossible without irrigation and pernicious malaria is an insuperable barrier to colonization in the presence of anophelines in great numbers In either case drainage has not eliminated the insect carrier of the disease

There is a sound biological reason why drainage as originally planned in the delta should have failed to eradicate malaria The insect responsible for the transmission of malaria in *Italy* as well as *in the rest of Europe* is *A maculipennis* a mosquito of the north temperate zone which finds its optimum breeding places in the cold waters of England Holland and Germany Its range extends as far south as the Mediterranean Sea but in these latitudes it is compelled to seek the coolest waters available and hence in summer it breeds almost exclusively in the vegetation along quiet edges of flowing streams and canals virtually disappearing from pools and shallow standing water Hence to get water into motion by drainage is not a deterrent but often an advantage to a mosquito with these breeding habits In Grassi s phrase we are merely converting an irregular marsh into a rectilinear one It is clear also why malaria can be so intense in the islands and south of Italy where marshes and swamps play an unimportant role It is the rivers of Sardinia Sicily and Calabria that are chiefly responsible

It is quite the opposite with the North American *A quadrimaculatus* This is a warm water mosquito whose range centers in our Southern states and extends only as far north as it can find suitable breeding conditions Naturally it seeks standing water well warmed by the sun and except in the very hottest summers avoids running water entirely It is not, therefore that

the lesson of Panama was ignored by the European sanitarians the fact is the results were not directly applicable Mosquito control through drainage has been constantly attempted in Italy but with indifferent success

To take the most conspicuous example, the Tiber delta drained with pumps since 1889, remained highly malarious and 90 per cent uncultivated for more than thirty years thereafter It was this situation which in the main, led to the adoption of state quinine in *1902* at the instigation of Professor Angelo Celli, a great pioneering name in Italian malariology

It is a mistake to suppose that state quinine was introduced in Italy to provide free treatment for malaria at the expense of the Government Here too, the financial burden was decentralized and the whole plan put on a practical basis by the simple scheme of making malaria not only a reportable but an occupational disease The responsibility for the treatment of malaria cases was placed on the landowners To prevent evasion of this duty the state through dispensaries in zones officially declared malarious employed local physicians to treat agricultural labor charging each landowner at the end of the year with his share of the total cost of the service including medicine and charging the budget of the town itself for treatment of other employes and the poor The state manufactures its own quinine and sells it at a small profit the proceeds being devoted to malaria control and to opening credits in favor of very poor communities to enable them to purchase quinine

What has been the effect of state quinine on malaria incidence and severity during the twenty eight years which followed the passage of this law? We may sum up the situation very briefly by saying that the effect on severity has been marked and incontrovertible The death rate from malaria has rapidly descended and cases of pernicious malaria are far less frequent now than before The effect on incidence has been almost negligible There has been no demonstrable quantitative diminution in malaria for many years past There are the well known minor fluctuations in malaria from year to year and many mild years may occur in a string to encourage those who are continually striving to prevent malaria by treatment But bad years due to favorable conditions for anopheline breeding over large areas regularly recur as in 1924 and 1930, and restore malaria incidence to its long term average in those places where entire reliance has been placed on quinine treatment or prophylaxis Quinine may be depended upon to mitigate the severity of the malaria and cut short the series of acute paroxysms, it cannot prevent relapses or the transmission of the infection

It has been increasingly evident to far sighted Italians in recent years that considerably more attention must be paid to the anopheline mosquito if they are to secure a reasonably rapid and successful result from the malaria program This has led to numerous surveys and field studies, which are always a prerequisite to action in the entomological field Prof Fermi became an enthusiastic protagonist of larva control as far back as 1912, and his experiments, followed by those of Grassi and Sella in the Tiber delta dating from 1917, aroused public interest and contributed greatly to our knowledge of malaria epidemiology and anopheline behavior In 1925 the Public Health Department, aided by the *Rockefeller Foundation, founded the* Malaria Experiment Station in Rome with field branches all over malarious Italy Out of such studies has grown the present well organized and nation wide program of anti mosquito work

Four additional anti mosquito measures not previously applied in Italy, nor for that matter in Europe, have been adopted in recent years with considerable success

(1) *Concrete Channels*—The engineers (*following the Panama practice*) have been making small concrete channels in the flat bottoms of drainage canals where the minimum flow is naturally mall or can be reduced by pumps to the capacity of the channels These keep the water moving are easily cleaned, and allow minnows to penetrate into every ramification of the system of ditches Such channels, with the aid of electric pumps and the cooperation of gambusia have been sufficient in themselves to eliminate anopheline breeding from the area surrounding *Ostia in the Tiber delta* and to abolish malaria Irrigation water has also been put into concrete channels

(2) *The Introduction of Gambusia*—This introduction from the United States has led to unexpected results In standing water and slowly moving canals or drainage ditches these little fish have accomplished an astounding multiplication No one accustomed to the behavior of gambusia in America could imagine the density which they can achieve under favorable conditions in European waters *Standing waters become* fairly clogged with them so t " peas

ants complain that the cattle refuse to drink From one lime sink in Istria about an acre in extent we took over four million gambusia for distribution purposes last year without apparently diminishing the number per unit of area No horizontal vegetation however thick can protect anopheline larvae from the fish large and small which constantly patrol every square inch of water surface In the area of about 8 square miles which we have had under observation for five years in Istria the spleen index in a scattered rural population has gone down from 98 per cent in 1924 to about 10 per cent in 1930 acute epidemic malaria is reduced to sporadic cases and a tuberculosis preventorium for Viennese children can now be operated throughout the year instead of being closed, as formerly from June to October There has been no case of malaria among the 300 children in the last two years Nothing but gambusia distribution has been done in this area

(3) *The Systematic Use of Larvicides About Centers of Population*—There are many communities in which malaria is due to the river breeding of anophelines and where drainage is not applicable nor gambusia successful Here Paris green has proved to be of the greatest value The routine application of Paris green under these conditions year after year is defensible and economical for several reasons The population is aggregated into compact villages so that in southern Italy about 88 per cent even of the small farmers live under urban conditions and only 12 per cent are scattered The farmers live in town and go back and forth to their work each day Such units of population are ideal from the point of view of antilarval measures Also the long dry season coincides with the season of malaria transmission and there is therefore no temporary water to handle as a general thing And finally labor is cheap the material inexpensive and the agricultural population already habituated to the idea of using poisonous sprays against insect enemies The Malaria Experiment Station has proved over and over again under all sorts of conditions that in Italy mosquito breeding can be prevented for less money that it takes adequately to treat the acute malaria in the local population Paris greening all unavoidable anopheline breeding places within 1½ miles of population centers is therefore standard practice now in Italy It is being extended as rapidly as surveys can be made maps drawn and personnel trained to all malarious communities in Italy south of Rome The financing of the work follows the same lines as that of quininization described above Anopheline breeding has been made a nuisance under the law and landowners are held responsible for eliminating it within 1½ miles of inhabited centers and in drainage districts To prevent evasion of this obligation the local authorities will see that it is carried out and the expense will be apportioned to the landowners according to the size of their holdings

(4) *Screening of Houses*—Of course mosquito proofing is not a new thing in Italy but it was limited to certain kinds of government buildings principally railway employes dwellings in malarious zones As late as 1924 there was general disbelief in the possibility of extending its use to the common people and especially to agricultural labor owing to the general poverty and the type of houses often ancient structures dating from the Middle Ages Nevertheless what can be done under such adverse circumstances is shown by the results of the energetic action of the Government of Rome which in 1928 made it obligatory upon all houseowners of the Roman Campagna to screen In 1930 the Malaria Experiment Station desiring to carry out some staining experiments on anophelines in relation to unscreened dwellings was unable to find unscreened bedroms in any part of the Roman Campagna Of course the screening had not always been properly done nor carefully maintained But education in the use and repair of screens has been introduced in the schools with mending the household screening as part of the home work

Perhaps the most important advance ever made in Italy in the war on malaria was the so called Law of Mussolini passed in 1928 governing the constitution and procedure of drainage districts These are now obligatory throughout Italy so that the reclamation of all fertile but uncultivated land must be begun within ten years A special bureau of bonification has been set up in the Ministry of Agriculture to organize finance and supervise these projects To be approved by the Government and receive its conspicuous subsidies the project must include not only drainage but also the construction of model farmhouses fences and roads the provision of a good water supply and adequate sewage disposal the screening of all houses and the elimination of anopheline breeding in the area a system of irrigation in closed pipes and open concrete channels which will not

cause a malaria hazard proper medical assistance and hospital facilities and a monthly subsidy to each family moving into the area sufficient to maintain that family until, by agriculture, it shall become self supporting This is the magnificent program of a relatively poor country without any natural resources to speak of except its soil and climate It is an attempt to improve the condition of health and standard of living of its most important population group, the tenant farmers

There is only one thing to add to this hasty resume of Italian anti malaria activities That is to mention the machinery which has finally and only recently been evolved to make the necessary preliminary surveys of malarious communities, to initiate and supervise activities to prevent duplication and overlapping of effort, to coordinate the different agencies which have entered the field of malaria treatment and prevention and to determine local cooperative programs in consonance with local resources and local conditions This machinery is the Provincial Malaria Committee Now an Italian province is a much larger unit than our county It has on the average a population of 500 000 people The Committee is composed of representatives of the

Health Department (provincial medical officer)
Public Works Department (provincial engineer)
Department of Agriculture (local agent)
The Red Cross
The Association of Landowners
The Syndicate of Farmers
Private agencies engaged in malaria work

Thus Italy which feels itself essentially an agricultural country is coordinating all available powers and resources to make a united front against the disease which more than any other is the enemy of the farmer restricting his movements paralyzing his efforts and lowering his standard of living

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DISCUSSION (*Abstract*)

Mr Nelson H Rector Cleveland Miss—The Italian differs in many respects from the American He in most instances favors work of a permanent nature even though it may require a much longer time for completion It is no unusual thing to see buildings in Italy which have walls eight or more feet thick and which have withstood the attack of the elements for centuries The Italian seldom works hurriedly and is seldom worried if many years are required for the completion of a single project

Dr Hackett mentioned that the Italians have reclaimed several areas that lay below sea level The quickest method for draining these areas would have been to pump the swamps dry However the Italians chose a method by the use of which it was possible to keep the unit cost per acre much lower I inspected some of this work in 1926 and found out that they place a levee across the lower end of the area in question The velocity of the streams coming down from the hills is checked by the levee and year by year the silt is deposited in the swamp until finally the area is high enough for cultivation The area can then be drained without the use of pumps I was told by the engineers in charge that it would probably require 50 years for the filling of the area that I inspected I doubt that we Americans would have patience enough to wait for Nature to do this work but would prefer to execute the work at once even though the unit cost would be relatively high

In the Yazoo Mississippi Delta the major drainage has been practically completed and the same holds true for Italy As Dr Hackett has just stated a plan is under way to make their major drainage system as near 100 per cent as is practical The Italians excel us on another point namely they maintain their canals reasonably well while in this country many of the large canals are allowed to fill by the growth of willows and other vegetation in the bed of the ditch These poorly maintained canals are often a favorable breeding place for mosquitoes

I understand that the universities and technical schools in South Carolina are giving a course on Malaria Its Cause and Prevention to the engineering students and I see no reason why all of our schools and universities (particularly those in the Southern states) should not include such a course in their curriculum It is indeed unfortunate that engineers coming out of our leading schools know nothing about malaria and are apt to create conditions that will be extremely difficult to correct in future years

Dr Hackett also mentioned that the Italian engineers are laying a small concrete ditch in the bottom of the large canals and I am of the opinion that we shall see many of our large canals lined with concrete in the near future Mr Fletcher of Memphis tells me that he is planning to grade several canals with concrete This permanent work will develop much more rapidly in Italy than in this country because the people of Italy live mostly in communities Statistics show that 80 to 90 per cent of the population of Italy lives in cities or towns while in America the population is dotted over large areas Our major malaria problem is now in the rural areas and it will be some time before it will be practical to line the canals in the rural areas with concrete The cost would be prohibitive

In Mississippi the towns are paying more attention each year to permanent work and I believe the time will come when very little larvicidal work will be required in our urban areas We are finding out that it is much better to build malaria out that is to rectify some defect in our drainage system each year and to look forward to the time when few mosquito breeding areas will remain in the vicinity of our towns

MOSQUITO CONTROL IN HAITI WITH ESPECIAL REFERENCE TO THE USE OF PARIS GREEN*

By S S COOK M D †
Port au Prince Haiti

Mosquitoes and their control are among the major problems of the Public Health Service of Haiti. While our chief concern is malaria, dengue and filariasis cannot be ignored. The inauguration of an airplane service between New York and South American ports with a stop at Port au Prince also brings about the possibility of the introduction of yellow fever.

Salt marshes along the coast and alkali flats in the interior furnish ideal breeding places for *Aedes taeniorynchus* and *Aedes sollicitans*. In a large fertile plain north and east of Port au Prince existence at certain seasons of the year is *almost intolerable because of these mosquitoes*. The same thing is true of many other sections of the island.

The preferential breeding habits of the different species are not so distinctive here as in many other countries. Anophelines are found in great numbers in such places as rice fields. They are also found in irrigation ditches, roadside pools, hoof prints, wells, springs and along the banks of rivers where algae have accumulated.

Aedes aegypti probably the most frequently found and widely distributed of all the species in Haiti, is primarily a container breeder but also breeds in tree holes.

Culex quinquefasciatus has only one preference and that for dirty water. *Aedes mediovittatus* is an annoying biter indoors in the day time. This mosquito breeds so far as is known only in tree holes.

Each of the ten public health districts of Haiti is in charge of either a naval medical officer or a Haitian physician commissioned in the Public Health Service of the Republic. In each of the districts an assistant public health officer is placed directly in charge of sanitation. His duties comprise the supervision of street cleaning, market inspections, drainage, filling, mosquito control, fly control and other sanitary activities.

Under his supervision the chief sanitary inspector directs the activities of the inspectors who have sanitary control of properties, markets, streets and so forth. In the larger towns zoning is employed and the divisions so made that the entire town is inspected every eight days. A card is made out for each property on which the results of the inspection are recorded. Mosquito breeding areas outside of the residential sections and in the small towns are handled according to conditions peculiar to each.

The funds for sanitation are obtained either locally or from the central government. Each town allots 5 per cent of its budget for sanitation. Those from the latter source are allotted monthly and are in proportion to the needs of the district and the total amount available. In addition to these sources an indefinite but small amount is received from individuals who reimburse the Service for work done on private property.

Supplies for the districts are issued by the central government and are limited by the budgetary credits received for that purpose.

Despite drainage, filling, destruction of containers and other measures, larvicides are still required in large quantities.

The supply of oil has seldom been sufficient adequately to control all breeding areas. The experiments with Paris green and moist sand previously reported[1] were sufficiently encouraging to warrant their continuance. A few of them are given in detail.

(1) *October 28 1929* at Bailey's Beach near Port au Prince were two parallel ditch rows in an abandoned rice field *were grown with grass and rushes*.

There was heavy breeding of Aedes and Culex (75-250 larvae per dip) with a scattering of first stage Anopheles.

The area was 36 square feet.

One teaspoonful of Paris green and 99 teaspoonfuls of wet sand were applied. This experiment was designed quickly to test the toxicity of a new lot of Paris green and therefore an excessive amount was applied. Within an hour 50 per cent of the larvae were dead and only a few were normally active. At the end of four hours all were dead.

(2) *October 8 1929* at Bailey's Beach near Port au Prince there was an abandoned rice field covered with grass.

Two to 7 Anopheles were found per dip with a scattering of Culex and Aedes. The area was 903 square feet.

One teaspoonful of Paris green and 99 teaspoonfuls of wet sand were applied at 11 10 a m, slightly more than one half pound per acre.

At 2 10 p m. (3 hours) in the entire area there were

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From the National Public Health Service of Haiti.

†Lieutenant Commander, Medical Corps, United States Navy.

found only 7 live Anopheles larvae and no live Aedes or Culex

(3) *October 30 1929* a rice field near Bailey's Beach was densely covered with native grasses and rushes The depth of the water was 1½ to 4 inches

Anopheles albimanus averaged two per dip *Aedes taeniorynchus and Aedes scapularis* 50 to 150 per dip

The area was 360 square feet

One half teaspoonful of Paris green and 49 teaspoonfuls of wet sand were applied at 3 20 p m one third pound per acre

At 5 00 p m (1 hour and 40 minutes) 80 per cent of all larvae were dead no live Anopheles were found The following morning no live larvae could be demonstrated

The areas treated on October [redacted] and 30 were checked on November 7 when no large anopheles larvae were discovered Those found were from 12 [redacted] 30 hours old Aedes were very scarce

A rice field consists of a series of square or rectangular plots diked on four sides to hold water After the rice is planted water is turned in from an irrigation ditch and the dike repaired so that the land is continuously inundated After the rice [redacted] harvested no further attention is paid to the land until time for another planting

With abundant water and sunlight algae flourish affording perfect breeding conditions for *Anopheles albimanus* Several species other than Anopheles also flourish in such places

(4) *October 31 19 9*—In Petit Goave several ponds in a marsh west of the city were treated with Paris green and moist sand mixed in the ratio of one part of Paris green to 99 parts of the sand These ponds presented heavy breeding of *Anopheles* and *Aedes* In one hour and forty minutes 90 per cent mortality had resulted and in three hours all larvae were dead This was a demonstration for the assistant public health officer and the inspectors On November 15 on another visit to Petit Goave a ditch that had been treated the day before by the chief inspector was checked This ditch is 700 feet long 1½ feet wide and the water in it averages 3½ inches in depth One teaspoonful of Paris green and 99 teaspoonfuls of moist sand were used The inspector reported heavy breeding before the application but no larvae were found afterwards

Prior to October 31 there had been a shortage of oil with the consequence that breeding was found all over Petit Goave and the surrounding marshes The use of Paris green was begun on November 1 and on November 28 an inspection was made of the whole area No larvae were found

(5) *December 10 1929*—The Garde rifle range near Port au Prince was a tidal flat with open water varying in depth from two to ten inches with heavy breeding of *Culex coruiger*

The area was 7 200 square feet

One and one half teaspoonfuls of Paris green with 150 tea poonfuls of moist sand were applied at 3 p m le[redacted] than one fifth pound per acre

Nineteen hours later the mortality was about 90 per cent

Considerable information was gained from these experiments and demonstrations indicating the feasibility of mosquito control by this method The simple field test for toxicity requiring a few minutes to do cleared up any doubt as to the lethal effect of this particular lot of Paris green Some of the Paris green remains on the surface of the water long enough to kill the Anopheles In fact where there was continuous observation of a treated area it was noted that they began to die before the other species

Amounts as small as one fifth pound per acre appear to be sufficient although with the smaller amounts killing [redacted] delayed Under ordinary circumstances very rapid action does not offer any real advantage

That the method offers no practical difficulties is shown by the case of Petit Goave The inspector was able after one brief demonstration successfully to cover his whole territory

Our experience in the above quoted instances and many others during the same period confirmed the original work of Griffitts done in 1926 and reported elsewhere

In January all districts not previously visited were given demonstrations in its use Some of these are of interest

(6) *January 9 1930*—Salt flat near Port de Paix contained open water without vegetation but with much floating debris The average depth was 4 inches There was very heavy breeding of *Aedes taeniorynchus* (200 500 per dip) The area was 9 720 square feet

Eight tea poonfuls of Paris green with moist sand at ratio of 1 to 100 were applied (7 oz per acre)

Within three hours 90 per cent mortality had resulted Control pools near by showed the larvae active

(7) *January 11 1930*—At Petite Anse near Cape Haitian there was a pond in the center of this little coastal village The water was open along the edges with a heavy growth of chara like alga in the center and varied in depth from two inches to eighteen inches

There was very heavy breeding of *Anopheles albimanus* (25 to 100 per dip) and fairly heavy breeding of *Culex nigripalpus*

The area was 20 250 square feet

It was treated at 10 00 a m with 5 teaspoonfuls of Paris green mixed with dry sand in the ratio of 1 to 100 (one eighth pound per acre) and checked at 3 00 [redacted] m (5 hours) Dippings over the entire pond revealed two first stage Anopheles and no Culex

On the same day at the rifle range near Petite Anse a pool of 250 square feet showing heavy breeding of *Aedes taeniorynchus* was treated with one half teaspoonful of Paris green in moist sand Six hours later only one live larva could be found in the pond This pond had a dense growth of clump grass

(8) *On February 6 1930* during the course of a mos

quito survey at Cayes, Anopheles were found breeding along the edges of the Ravine du Sud This stream when in flood erodes the banks leaving irregularities which in dry weather collect algae and debris In all of them breeding could be found All such places within a mile of the city were treated with Paris green and moist sand Check on the following day revealed no larvae

Since its adoption on January 1, 1930 as the routine larvicide Paris green has proven very satisfactory to the public health officers as evidenced by their monthly reports Its cost is so small compared to oil that they are able to use it in unlimited quantities It is much easier to tran port than oil and sand for diluting it can be found everywhere Unless large areas are to be treated an inspector can easily carry a day s supply in his pocket mixing a new batch as he needs it Fine moist sand from any convenient source is used Sieving through 18 mesh screen removes the trash and small rocks and gives a more even mixture Thorough mixing of the two should be done

If the sand is too wet it clumps and does not spread well and on the other hand if it is too dry the Paris green does not stick to it The unit of one teaspoonful of Paris green to 99 teaspoonfuls of sand is a convenient one as this amount can be readily mixed in a dipper

It has not been found practicable to teach its application on the basis of poundage per acre The size of water deposits varies so much that there does not appear to be any way to have the inspectors visualize an acre The inspectors are told to sprinkle it lightly and check the next day for results

It has to be applied by hand a procedure which the laborers and inspectors soon learn The wind does not help in the distribution as in the dry mixtures so that the entire area has to be covered thoroughly

In areas where only *Anopheles* control is desired a 5 per cent mixture in lime is employed This mixture distributed with the aid of hand power dusters has proved very effective

For the first eight months of 1929 oil for all the districts cost $5 815 95 During the same period in 1930 the following year the cost of oil and Paris green was $3 426 32 a saving of 41 per cent. The reduction in expenditure for mosquito control is actually greater than the figures indicate because a part of the oil is used in latrines for fly control It is not practicable to separate the two as one oiler in the course of his rounds may do both mosquito and fly control

In the district of Port au Prince in 1929 2,000 gallons of oil were used each month Since the adoption of Paris green comparable results are obtained with 500 gallons of oil and twenty pounds of Paris green In other words it has been possible to substitute 20 pounds of Paris green for 1 500 gallons of oil At the prevailing price of 20 cents per gallon for oil this means a monthly saving of $295

Paris green does not affect pupae.

With its widespread use in pastures and other places to which animals have access none of the public health officers have noted any ill effects on animals

SUMMARY

(1) Paris green mixed with moist sand in the ratio of 1 to 100 by volume is an effective larvicide for general use in Haiti

(2) During the eight months in which it has been used the expenditure for larvicides has been 41 per cent less than for the same period in 1929 the previous year

(3) It has been used in pastures and other places accessible to livestock without causing apparent harm to the animals

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DISCUSSION (*Abst a t*)

Dr T H D G ff ts Albany Ga—This i a report of the practical application of Pa is green on rather a large scale for the control of sub-surface feeding larvae the de truction of the salt marsh type of mosquito In the salt marshes of the Atl tic and Gulf states they b eed generally in shallow wat r It is rather ra e to f nd extensive breeding areas in water over 18 inches deep more generally it is a question of less than a foot Paris green put out as Dr Cook has described w ll k ll not only Anopheles but Aedes and Culex in such waters

It s particularly pl asing to me to have a report of the pr ctical r sults of general mosqu to control at a low cost by this Paris green method

Dr Cook (*closing*) —We not ced that Anopheles d ed first The breeding cale varies, 5 or 6 to 106 for Anopheles. You cannot et any fixed limit We have used it in water up to 12 and 14 feet depth and gotten good results.

POSSIBILITIES OF MOSQUITO PROOFING ALL RURAL HOMES IN A COUNTY*

By J. P. MOON, M.D.,
Tiptonville, Tenn.

For the past three years the County Health Unit of Lake County, Tennessee, has been attempting to mosquito-proof all the rural homes in the County. It is hoped that a brief resume of the procedure employed, the problems involved, and the results accomplished may be helpful in indicating the possibilities of carrying out a similar project in other counties where there is a definite malaria problem.

Lake County, located in the northwest corner of the State between the Mississippi River on the west and Reelfoot Lake and the Spillway on the east, consists entirely of Mississippi bottom land, most of which is subject to overflow. It is traversed by numerous sloughs, many of which contain water throughout the year. It also has many ponds, pools and marshes which furnish ideal breeding places for *Anopheles quadrimaculatus*.

Lake County has an area of about 156 square miles (100,000 acres). The population according to the 1930 census is 10,486, but it increases by about 2,000 during the summer and fall of each year, owing to the inflow of wage hands to work the cotton crop. The records of the county court clerk show that the ownership of land is distributed among 260 persons, as indicated in the following table:

No. Land Owners	Acres Owned	Per Cent of County
16	1000–5000	40
44	300–1000	30
200	1– 300	30
Total 260	100,000	100

The land is cultivated largely by tenants, crop shares and wage hands, resulting in a high percentage of turnover in population each year.

This system of land ownership has made it necessary to deal with four distinct classes of people: first, the landowners, many of whom live outside the county or State; second, the agents, persons responsible for renting the farms; third, the tenants, or renters, who occupy a farm for at least a year and sometimes many years; and fourth, the wage hands, who crowd the shacks when work is to be had, but may be gone tomorrow, taking part of the house with them. The small number of landowners is an advantage, in that the cooperation of relatively fewer people is necessary than in a county of many small landowners, but the cooperation of non-resident owners is not easy to secure, the cost of screening to individual owners is greater and the floating population makes maintenance of the screens in good condition a serious problem.

The number of rural homes in the County, according to a recent survey, is 1,846. A large percentage of these consists of one- and two-room shacks with lean-to kitchens. The walls and floors usually have many cracks and holes, ceilings are lacking, and the roofs often leak. The number of weather-boarded houses with good ceilings and tongue and grooved floors, probably does not exceed 10 per cent of the total.

The Lake County Health Unit started operating in September, 1927. Malaria was considered to be a major health problem and the death rate from malaria was the highest in the State (68 per 100,000 for the years 1925-6-7). A malaria survey of a community in the area subject to overflow made in July, 1928, gave a history index of 69 per cent, a spleen index of 57 per cent, and a blood index of 40 per cent (Meleney, Bishop and Roberts, 1929). School surveys with the cooperation of the United States Public Health Service in the same year showed a positive blood incidence of 11.2 per cent in March and 13.7 per cent in September. The survey would probably have given a higher incidence had not quinine been widely distributed in schools during the summer.

ORGANIZATION OF CAMPAIGN

In April, 1928, several of the most influential landowners and members of the County Court were invited to a meeting at which the State Health Commissioner and other members of his department and Mr. J. A. LePrince, of the United States Public Health Service, discussed the need of formulating a malaria control program for the County. At this meeting the Lake County Anti-Malaria Association was organized and a committee of five of the larger landowners was appointed to cooperate with the Health Unit in conducting a campaign to mosquito-proof the rural homes of the County.

It was decided that the County Health Unit was to secure orders for screening from the landowners, manufacture the doors, screen the

*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Fourth Annual Meeting, Louisville, Kentucky, November 11-14, 1930.

F g 1

HOUSE SURVEY AND RECORD SHEET

LAKE O NTY ANTI MALARIA PROJECT

Dist N 3 Road 33 Hou N 158

Ow A E Markham

Age Harry Wade

Tena Milton Wilson

eas emen d y I N Vandergruff Da 5-18-30

DOORS

umbe of oors 3 Da med 5 26 30

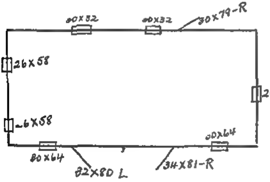
Date doors fal factory 5-29 30

Is Health Uni to han doors, Yes N X

Time ha g doors, hrs 45 min A n 15¢ ap initials I N V

WINDOWS

Number of windows 7 T al Sq Ft 71



ned I N Vandergruff

homes collect the bills and furnish this service at cost A modern building was loaned by Col A E Markham for the manufacture of doors and the American Red Cross made immediate operation possible by furnishing the necessary equipment The Anti Malaria Committee provided a rotating fund of six hundred dollars and secured from hardware and lumber concerns a ninety day credit allowance This furnished a sum of about two thousand dollars with which to begin operations

Record forms were devised consisting of a work sheet and door tags (*Figs 1* and *2*) These gave the location and ownership of the house number location and size of doors and windows and other necessary information The identification tag accompanies each door as it is assembled in the factory shows on which side to apply hinges and its location on the house Accounts were kept in a ledger with details as to cost of doors, wire screen for windows and labor

METHODS OF PROCEDURE

The first procedure was to obtain screening orders from the landowners It was anticipated that this would be one of the most difficult problems but it proved to be a minor problem Most of the larger land owners in local residence readily consented to screen their houses The screening of these houses at once created a demand on the part of the tenants for screening their houses which brough in orders from many landowners in all parts of the County As soon as orders were secured a member of the County Health Unit took measurements for each door and window and the factory personnel proceeded to manufacture the doors

The factory was constantly under the supervision of the County Sanitary Inspector or the County Health Officer At first negro labor was employed but this was found to be unsatisfactory and later high school boys were employed with much better results The boys were paid two dollars per day on the basis of their ability to complete ten doors per day which insured a labor cost of twenty cents per door During the summer an experienced carpenter was secured at the same wages to act as shop foreman and laborer as well

Houses were screened as soon as the doors were completed This was done under the supervision of the County Sanitary Inspector The screen door was fastened to the frame by a hinge strip the length of the door and was cased in by 1 inch strips to prevent the ingress of mosquitoes about the edge In many cases it

19 0

Fig 2 OWNER Joe Moore

TENANT Bob Moss

D 3 R d No 21 H use No 181

Doo L tt a Ope R X Ope L

FROM

LAKE COUNTY ANTI MALARIA ASSOCIATION

Co-ope t g W th

LA E COUNTY HEALTH UNIT

I I Ow Asse b X

was necessary to provide a new door sill as well Windows were screened from top to bottom by sixteen mesh galvanized iron screen tacked on to the outside of the window frame with a two inch lap

Transportation of doors screening and lumber to the hou es was one of our difficulties for the first year and a half Usually a wagon from the community would call for the doors belonging to a number of houses Occasionally doors were shipped part way by freight Because of the de lay often occasioned by this haphazard means of transportation the State Health Department last year loaned the County a motor truck, which solved this problem

Upon the completion of screening of a house or group of houses a bill was presented to the landowner A few landowners who always had ready money paid promptly, but the great ma jority could pay only in the fall and winter when the cotton crop was in This led to the rapid exhaustion of the available credit, so that at one time in 1928 the outstanding obligations amounted to $2 300 00 Collections were all made by the County Health Officer or the Sani tary Inspector, and occupied so much time that other work of the Unit had to be neglected At the same time the filling of orders for the screen ing had to be suspended Ultimately, however, practically all bills were collected or are now awaiting collection at the end of the present cotton picking season

INSIDE MOSQUITO-PROOFING

Complete mosquito proofing usually requires in addition to screening papering the walls and ceilings stopping holes and cracks in floors, closing flues and placing naphthalene in chim neys Of these measures only the papering has been started in Lake County to date This work began in the fall of 1928 Upon the rec ommendation of Dr C P Coogle of the U S *Public Health Service the heavy brown wrap* ping paper used for cotton samples was em ployed The paper is of extra heavy tough fiber 36 inches wide and of varying length It was obtained from cotton factors and pickeries in Memphis and other near by centers At first the only cost of the paper was for trans portation but during the past year the demand has been so great that it has had to be pur chased at a price of 70 cents per hundred pounds It was transported to Lake County by freight or truck and was sold to landowners or tenants for a cent and a half per pound Some landowners have purchased paper for their *houses, but in many cases it has been purchased* by tenants The actual papering has been done entirely by tenants after a brief demonstration. This has reduced cost and has given the tenant an active interest in his own protection from mosquitoes The paper is applied with tacks protected by card board discs and is overlapped in corners in such a way as to avoid any open ings for mosquitoes Papering is especially de sired by the tenants because of the additional protection it gives them from the cold during the winter

COSTS

Detailed data on the cost of screening in Lake County was reported by Fullerton (1929) Doors were sold during the first year for $1 50 each, but this was found to be too low a price to cover overhead expenses and the price was raised to $2 00 the following year A brief summary of the cost of screening and papering a house is as follows

	No	Cost
Doors per house (average of 253 houses)	2 8	$ 5 60
Windows per house (average of 100)	4 75	
Average sq ft per window	12.5	2.06
Labor		77
Paper (average per 3 rooms)		1.35
Tacks (average per 3 rooms)		60
Total cost for average 3 room house		$10.38

RESULTS

The record of homes screened and papered up to November 1 1930, is as follows

Homes screened in 1927 (American Red Cross)	165
Homes screened in 1928 (County Health Dept)	880
Homes screened in 1929 (County Health Dept)	215
Homes screened in 1930 (County Health Dept)	300
Total	1560
Homes papered to Nov 1 1930 (approx)	500
Estimated cost of screening to landowners	$8500

The above statement indicated that 84 5 per cent of the rural homes of the County have now been screened Although this accomplishment is the source of some satisfaction I am fully aware of the fact that adequate protection from malaria will not be secured until all homes are entirely mosquito proofed and until the people are prop erly instructed how to use and maintain the mosquito-proofing

It is impossible at the present time to make any definite statement as to the effect of the screening so far accomplished on the incidence of malaria in Lake County The results of the blood surveys in three communities and in the schools of the County for the past three years

Table 1

COMMUNITY SURVEYS FOR MALARIA
LAKE COUNTY TENNESSEE

	Percentage of Positive Blood Specimens		
	1928	1929	1930
Cottonwood	40 0	32 8	15 8
Hathaway	18 0	9 8	4 3
Madi	16 0	9 7	10 5

Table 2

SCHOOL SURVEYS FOR MALARIA
LAKE COUNTY TENNESSEE

	Percentage of Positive Blood Specimens		
	1928	1929	1930
Spring	11 2	6 5	8 8
Fall	13 7	16 1	10 5

are given in *Tables 1* and *2* The communities showed a slight decrease in incidence in 1929 and a more marked reduction in 1930 The schools showed a slight increase in 1929

Since 1930 has been a very dry year in contrast to the two preceding years further comment on the results is not warranted at the present time

MAINTENANCE AND EDUCATION

The problem of maintenance is properly the responsibility of the landowner but many land owners do not reside in the County and others are woefully indifferent Hence because of the *public health menace involved the County* Health Unit must concern itself with this problem In spite of the eagerness on the part of tenants to have their shacks screened we have found that in many cases after several weeks or months the screen doors and windows have been grossly abused The installation of screen is to many tenants only a novelty or at best a substitute for their former habit of smoking out the mosquitoes and closing the doors and windows to obtain a good night s sleep Many of them however will not even maintain this advantage by taking good care of their screens

There is no doubt that in education we have the keynote to solving one of our greatest difficulties in a screening program The landowners must be shown that screening costs less than doctors bills and food supplies for sick tenants for whom they are responsible The tenants must be instructed on the cause and transmission of malaria and on the necessity of maintaining and properly using their screens Our intensive educational program in Lake County began after the screening work had been in progress for more than two years It should properly precede the screening work and run parallel with it The educational program in Lake County has consisted of three main features Talks on malaria accompanied by moving pictures have been given in the schools Carter s Malaria Primer has been distributed in the schools to be read by teachers and children as part of their school work Mosquito larvae in small hatching chambers have been placed in the schools to be observed as they emerge into adults This program will be extended to reach more adult groups in the future

In order to follow the degree of maintenance of screening and to determine its weak points a survey of the entire County was made during the summer of 1930 by inspectors furnished by the State Health Department In this survey each rural home was numbered by a permanent metal plate and was accurately located on a district map The physical condition of the house and screens were recorded on a special form The results of this survey have not yet been analyzed but our intention is to use the data as a guide to future work and to observe the condition of the houses from year to year

RECOMMENDATIONS

(1) I would recommend that an adequate rotating fund with which to carry on the work be provided (not less than one thousand dollars)

(2) Cooperation of resident citizens who will assume the responsibility of financing campaign

(3) Dry lumber should be used in manufacturing doors and an additional strip 1x3 inches should be nailed at the bottom of door to prevent the wire from being kicked loose

(4) Adequate transportation for screening material and doors

(5) Competent shop foreman constant supervision and inspection with good labor

(6) Educational campaign should precede and run parallel with the screening work This in my opinion is most important

(7) A better understanding or cooperation between landowners and tenants in the maintenance problem

While I have emphasized consciously the difficulties involved in the program, yet it is only fair to state that our program was begun immediately following the devastating flood of 1927, and continued through another in 1929, which brought on the County the worst economic conditions in a number of years I have no doubt that under conditions more nearly normal the work would have been easier

Can the methods used in the screening work in Lake County Tennessee be applied in mos quito proofing the rural homes of other coun ties? This question has frequently been asked The answer I believe is in the affirmative We have made mistakes by which others may profit and have accumulated information which others may use in beginning such a program

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Once in the Canal Zone in one house I found two mosquitoes in a bathroom I knew the regulations I telephoned down to the sanitary in pector over th district *In a few minutes he came up in a truck with* five negro laborers In a short time they found where the mosquitoes were and called the inspector in and he dropped them into a test tube He found they were not the kind that breeds in houses He phoned the quarterma ter s department and more men arrived in a *truck and discovered a few openings through which* these mosquitoes had come in The sanitary inspector knowing that these mosquitoes were not hou e bred got a map of the district He knew every quarter screened They went over the di trict in pecting each pot and found where a leak had occurred in a p pe and there *was a small pool That was oiled and a guard placed* to in pect every hou e in order to be sure that no other house had leaks in its screen wire where these mos quitoes could enter It hows the necessary thorough ness of the work Unfortunately the le son in Lake County is lo t on most of us it is l ke throwing a rock *in a pond The ripples are big in the center and get* smaller as they ne r the edges

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The investigational studies conducted by the U S *Public Health Service together with the opportunity* to demonstrate screening in these houses following the flood of 1927 undoubtedly won more converts for mos quito proofing this type of home than any other known method could have in ten times the length of time

In 1924 only 65 screen doors of this type were made and only 20 farm tenant homes in the malaria belt were known to have been mosquito proofed Today six years later we have records of over 70 000 screen doors of this type and approximately 20 000 rural ten ant homes screened This is pretty good proof that this type of screening and mosquito proofing is being adopted generally over the malaria belt The Bureau of Census lists approximately 1 622 000 farm tenant houses in the malaria belt of fifteen states or an aver age per state of 108 133 Therefore 20 000 is to 1 622 000 or 1/81 of the problem or 1 25 per cent

Malaria is not uniformly prevalent throughout the malaria belt of our country We have good reason to believe that malaria foci vary in size and are irregu *larly paced However it is our belief* that even though malaria is not uniformly distributed over our land it is very e sential that screening and mosquito proofing be uniformly complete if we are to stamp out the disease

It is a well established fact based on a thorough piece of investigational screening work *that in a large* area in the Mississippi Valley where no screening or other anti malaria activities were under way malaria remained practically unchanged from year to year Whereas in a similar area where screening and mos quito proofing were uniformly completed the disease is getting milder and gradually fading out of the area

In a completely screened area one may expect the following

(1) Fewer attacks of malaria
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There are many thousands of famil es living in un screened homes today who never lived in a mosquito proofed home It seems to be a general consensus of opin on among malaria field workers that once one

can induce these people to mosquito proof their homes the contrast registers and is firmly fixed in their minds and they usually thereafter think of screens as a necessity

Screening is within the reach of everybody living in the malaria belt of the United States today if they will put forth sufficient effort to obtain it The average income of the tenant class is approximately $1 000 per family per year It would cost approximately $10 or 1 per cent of the income to screen a house with a yearly maintenance of approximately $1 00 per season or 0 1 per cent

It is of course possible for the cost to be lightly more than that mentioned when installation and maintenance are included particularly if a family is careless and permits children to mutilate the screens thus requiring much replacement and repairs. The rich can buy screens if they want them The middle class can buy screens The average tenant class can buy or can obtain credit for screens The indigent class can obtain screens through charity organizations if the proper appeal is made

The possibilities of screening all rural homes in the malaria belt will soon become an actuality It will be brought about by first education second demonstrations of effectiveness of screens third eternal vigilance on the part of the enlightened public and particularly all public health workers

The fundamental principles of mosquito proofing in rural sections are applicable in any section county or state in North America Public health field workers must possess some ingenuity and create ways of shifting their material resources as well as formulate schemes successfully to use the materials at hand

A public health worker health educator health instructor or whatever one chooses to call him rightfully and *truly deserves a star in his crown when he* has stamped out malaria in his given territory It is evident that he has utilized both physical and mental resources in constant work

To destroy all mosquito breeding places in the Mississippi Valley would be an enormous task too expensive to be considered at this time Urban mosquito control by destroying many of the breeding places and treating the remaining breeding places with oils or poison is thought to be feasible and practical and the results in disease reduction well worth the expenditure for the purpose Many urban families and individuals visit in the malaria infested areas of rural sections and there receive malaria infections to return to their urban homes and come down with the disease Urban mosquito control does not always mean urban malaria control However urban mosquito control offers protection to those individuals who remain in the mosquito free urban centers.

Screening and mosquito proofing are just as applicable to rural homes as to urban homes and at this present day seem to be the key to the solution of the people s protection from mosquitoes that can be relied upon and is well within the means to do

The reduction of mosquito breeding places in an effort to reduce the number of Anopheles mosquitoes is at this time thought to be too expensive and impractical for the reason that the physical conditions in the Mississippi Valley which are extremely favorable to the propagation of these mosquitoes will not be materially changed within the next fifty years

Economists in agriculture and business have estimated that the point is about to be reached where reclamation of land for farm purposes under the present known methods is more expensive than lands of similar productiveness can be purchased for and until the demand develops for more land the reclaiming of swamps and bayou beds by digging and maintaining great drainage ditches will very likely be indefinitely postponed.

*By no manner of means is the majority of the breed*ing places used by the Anopheles mosquito confined to large swamps and bayous Every artificial container that holds water every depression ditch and even wagon tracks and animal hoof prints may hold water sufficiently long to be a potential breeding place for Anopheles mosquitoes if not an actual breeding place

Dr E L Bishop Nashville Tenn —From the point of view of the State Department of Health this work in Lake County is a study of the value of mosquito proofing as a control measure We do not feel that we have enough information as yet to know whether it is effective or not I believe it will be a help We will probably have to extend the work in Lake County into the problem of housing There are certain classes of residences which it is almost impossible to render mosquito proof because of bad construction or bad repair

Dr Moon has carried on a program of general county health work in addition to the malaria work and that required a great deal of his time

*Dr Moon (closing) —*One cannot foresee the real difficulties in a county wide screening campaign at the beginning We were inclined to believe that securing orders for screening from the landowners would be our chief problem This was not true To our surprise we found the landowner usually willing to cooperate. His chief concern was the care taken of the screening

They did not object to buying screening once satisfied *that the tenants would use it properly Another thing* I might mention is that in some few instances landowners were induced to screen these houses by creating a desire for protection from malaria on the part of these tenants This will usually produce the desired results. Usually the screening of a community would create a desire on the part of other tenants for screening

A definite estimate as to the effect of the screening *so far* accomplished on the incidence of malaria in Lake County was impossible The blood surveys showed only a slight decrease in the past three years with a slight increase as shown on tables in some localities in the year 1929 While this is true it might be misleading During the spring and fall of 1929 it was noted that while Lake County had only a slight increase in malaria incidence the adjacent counties and states up and down the Valley had a *decided increase* in some instances as high as 50 per cent.

Can the methods used in the screening work in Lake County Tennessee be applied in mosquito proofing the rural homes of other counties? This question has frequently been asked The answer I believe is in the affirmative We have made mistakes by which others may profit and have accumulated information which others may use in beginning such a program

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Larvicide application is the ideal method of malaria control in such an area If Paris green is used the expense is reasonable

As a basis for estimating probable costs one can use Griffitts* figures of approximately $4 00 per acre of breeding surface dusted throughout the season of May to October If breeding surfaces are rather extensive (even as high as four acres to the square mile) the cost would not be excessive to an average county At the prevailing rate the season s expense would approximate six to eight thousand dollars which is within the budget of the average county

Concentration of population allows larvicide application in selected areas Numerous breeding areas distant from habitation can be ignored If areas which must be treated average approximately one acre per square mile the annual cost to the average sized county may be as low as $2 400

SCREENING

In sections where land values are comparatively low where *quadrimaculatus* producing areas are numerous and homes are scattered screening offers the most practicable solution to the malaria problem As the county is prevented from spending public money on individual homes an adequate revolving fund must be raised An energetic county health officer can then secure the screening of most of the homes in his territory Where there are no large landowners to contract individually for the screening of a considerable number of tenant homes much time must be spent surveying homes and persuading tenants to screen As the cost of completely mosquito-proofing individual tenant homes has been brought so low approximately $7 00 per home abject poverty can be the only financial argument against a screening campaign The cost of this method to the governing body can be as low as the salary and transportation of one man

CHOICE OF METHOD

It is no longer good policy to pick a single method and insist that it be applied over a large area unless a careful survey has indicated that that will be *the most effective* The size and population of every county can be determined from maps and census records and the population concentration estimated by a quick motor trip over the main roads This trip will also indicate which sections must be searched for breeding areas It is not necessary to dip for larvae in all collections of water anti malaria workers of moderate experience after examining a few examples of each type of breeding place can estimate the producing acreage with negligible error Detailed mapping of breeding places can be done after control work commences

Occasionally all data necessary to a choice of method and estimate of cost is on record A blood index completes the epidemiologist s information Such brief topographic and demographic studies will eliminate an impracticable method The cost under each remaining method should be estimated and the best plan chosen which the county can afford

In Italy an excellent land reclamation project accompanied by complete anti mosquito drainage failed because the land produced nothing better than sorrell grass In India a larvicide campaign proved ineffective because the labor available was of such low mentality that breeding areas were constantly overlooked One of our own screening campaigns was useless because the people slept in the street in hot weather These incidents emphasize the necessity of making a comprehensive epidemiological study of carefully weighing the evidence collected and of suiting the method of control to the conditions found

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D T H D Griffitts USPHS Albany Ga—Dr Bishop referred to the work in Tennessee as an experiment rather than a *demonstration in malaria control* In one county in southwest Georgia where malaria has been quite prevalent we are conducting a study in the control of malaria in an area of 343 square miles We are attempting to control malaria by the use of Paris green over the entire area So far the cost has been $4 00 per acre of water surface

I think while we may not ourselves be able to bring about such a change it is an important question whether we are going to continue to attempt to control rural malaria in poor sections of the State where we have negro tenant farmers scattered over large areas or whether some time in the near future we are going to try to change conditions of living so as to get the now scattered population housed in communities where public health work may be feasible It is something to think of something to work towards that we may possibly use some means to change our conditions in the rural South so that we can bring these people into communities and secure not only effective malaria control, but protect health in other ways It is expensive regardless of the measures to do effective malaria control or general health protection with people scattered very thinly I have attempted to get landowners in one county to hold a meeting for the purpose of considering it I doubt whether one half of the tenant houses in the county are worth $100 00 apiece I think it would

RURAL MALARIA CONTROL A COMPARISON OF METHODS*

By L L Williams Jr,†
Washington D C

The feasibility of rural malaria control having been demonstrated by more than one method, anti malaria directors must weigh the advantages of each in a given area and make a choice of method In sparsely settled districts those charged with the control of communicable diseases have been confronted with the question, Can malaria be controlled at all? Any suggested plan that eemed practicable and easy has been eagerly seized upon and has come into widespread use If it did not produce the desired result its popularity slowly waned, as instanced by the rise and fall of the top minnow

Drainage which obliterates all breeding places is of course, the best method Regular application of a larvicide is the second choice, as it is in the long run, more costly, requires more continuous effort and allows a greater chance of failure through the occasional overlooking of breeding places Lacking opportunity to engage in either of these methods one must fall back on screening which affords each individual an opportunity to protect himself but at best does not insure automatic protection to every one and is not everywhere applicable

DRAINAGE

Major drainage has never had a fair chance in rural anti malaria work Inaugurated primarily for land reclamation purposes no provision is made for residual drainage Flat gradient ditches quickly pot hole and *quadrimaculatus* in abundance can usually be found over the entire area In a tract of very soggy land in one of our Southern states there was no large expanse of open water, surface collections were small very shallow, and all densely shaded by trees bushes or heavy grass Quadrimaculatus was found only occasionally Malaria was no problem in the farming population near by After two years of extensive ditching for reclamation purposes the land was well dried, but long, broad canals of backwater crossed the area at half mile intervals To delay silting the ditches had been cut with bottoms below grade Vegetation lined the banks, quadrimaculatus abounded, malaria became a serious problem even outside the reclaimed area

Even in the Mississippi Valley reclamation districts where malaria control was emphasized and where the very slight fall in grade was conserved, most of the main ditches became ideal breeding places for quadrimaculatus Maintenance looked toward agricultural reclamation rather than health conservation

The greatest drawback of all is the practical necessity of forming a drainage district Our laws are cumbersome and multitudinous One company desiring to eliminate opposition, purchased all the land to be included in a proposed drainage district Nevertheless, eighteen months elapsed from the date of filing of the first petition before the district became a legal entity

State health departments could very profitably study the drainage laws of their states Most of these laws should be simplified and yet have added to them specific provision for anti malaria work It is significant that the preamble of many drainage laws contain the words and for the promotion of the public health' This is usually the last time public health is either mentioned or conserved in the law Most counties have the necessary legal authority to provide major outlets for road drainage Armed with this authority, acting as a unit, a county may secure major drainage in spite of cumbersome laws

A county containing a city or large town within its boundaries should consider major drainage as the method of choice With the city s drainage as a nucleus work could be gradually extended until the county became a drainage unit The greater land values prevailing near the larger communities make the financing easier and the increased value of land which follows drainage renders it still easier to provide for maintenance

LARVICIDE APPLICATION

In sections where people are clustered in small towns or villages where the breeding places are numerous and small and where the fall of the land is slight major drainage becomes impracticable The development of good roads and cheaper tran portation tends to the abandonment of isolated homes and the consequent growth of villages Community life, with it community interests, develops more social activity after dark with the consequent increase of exposure to the bites of nocturnal mosquitoes

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*Read before National Mala ia Committee (C nference on Malaria) m eting conjointly with Southern Medical A sociation Twenty Fou th Annual M eting Louisville Kentucky November 11 14 1930

†Surgeon U S Public Health Service

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be good if it were possible to re establish these houses on the main highways in communities so it might be possible to control malaria It is difficult to control malaria in a scattered population until we do finally bring about different housing conditions and get the people into communities We know the negro likes to be in a crowd likes community life Although they may live a half mile apart we know that they get together at night and herein lies a difficulty in malaria control by screening

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METHODS AND APPROXIMATE COSTS OF MALARIAL PREVENTIVE MEASURES ON HIGH ROCK LAKE IN NORTH CAROLINA*

By D Clark †
Badin N C

The Tallassee Power Company s High Rock reservoir is located on the Yadkin River and lies principally in Rowan and Davidson Counties, North Carolina the extreme upper end between the North and South Yadkin Rivers being in Davie County North Carolina

The general topography of the area immediately adjacent to the dam site is rough and hilly the remainder is rolling to flat and the lake as a whole especially in the upper river and creek sections is very shallow In the up river section of the reservoir for a distance of about eight miles the banks along the river channel are higher than the maximum elevation of the lake while the bottom lands back of these banks are from one to six feet lower consequently with a full lake these river banks form a continuous string of long narrow islands The shore line of this lake is extremely irregular and has hundreds of long narrow, shallow bights or bays some of which extend back a thousand feet or more

The adjacent area within one mile of this reservoir is thickly populated and occupied by a prosperous farming community some of it is highly productive and it includes the towns of Salisbury Spencer Yadkin Linwood Lexington and Southmont, having a total population of about 35 000 people

The State Board of Health, knowing that work on this development would start in the autumn of 1926 decided to make a malarial survey of the entire area of the reservoir and the adjacent territory within a distance of one mile of the proposed lake when at its maximum elevation This survey was started in the summer of 1926 and continued until late fall of 1927 A complete malarial history was compiled of every inhabitant within this area blood smears were taken and the spleens examined Also all known and potential mosquito breeding places were frequently examined, catching stations established and the density of Anopheles production determined This survey disclosed a large number of cases of malaria in this area, that the production of Anopheles was general over the entire basin, and in places was extremely heavy

The lake is formed by a concrete dam sixty five feet high across the Yadkin River at Stafford s Mountain just above High Rock, which impounds the water a distance of approximately twenty five miles up the Yadkin and up some of the creeks for a distance of approximately sixteen miles In addition to the area adjoining the river, the water is backed up six large creeks in Davidson County namely Flat Swamp Abbotts, Crow Swearing North Potts and South Potts and six large creeks in Rowan County namely Panther, Dutch Second Grant, Crane Deals and Second Creek The total area below the flood line of the lake is approximately 16 000 acres, 10 000 acres of which was covered with a heavy forest growth which it was necessary to clear prior to impounding water The distance around the shore line of the lake is 366 miles

The construction of the dam and the clearing of the reservoir was started September 1, 1926, and continued until the entire basin was completely cleared and all unmarketable logs, brush and trash burned, which work was completed January 1 1928

Before impounding the water a force of competent men was organized to keep the lake in a wholesome condition and to control the production of mosquitoes The large area of the lake and the long shore line made the question of transportation of great importance, and it was found advantageous to establish a permanent camp at an easily accessible centrally located place and to use boats for transportation A site was selected just above the mouth of Crane Creek on the Rowan County side of the lake and a permanent camp established on a high well wooded knoll close to the lake which at this point has a very steep and abrupt shore which even when the lake is drawn down will permit a landing close to the camp

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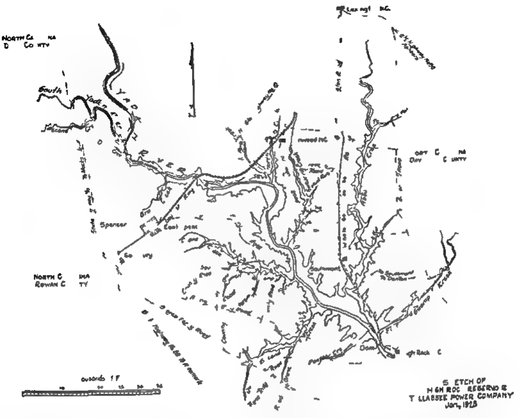
*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†Superintendent Tallassee Power Company



In building this camp there were utilized fif teen tents formerly used by the clearing crews The sizes and uses to which these tents are put are as follows

N	Si	Pu p e
2	0x30	War hous
1	0 30	I itch n
	0x 0	Col d bu k h ses
1	0 30	C l ed m hall
1	0 30	C lor d w sh hou
1	0 30	Offic
1	16x 0	White m hall
3	16 0	Whit l ping qua te s
1	1 15	Co k q art
1	1 15	White epl g arters
1	1 x15	White wash hous
15		

Both wash houses are equipped with modern plumbing have hot and cold running water shower baths and toilets all of which discharge into a septic tank

The camp has accommodations for ten white men and sixty colored laborers During 1928 the personnel of this camp consisted of five field men one of whom is in charge and supervises and directs all work two labor foremen, one re pair man and one white man whose principal du ties are truck driver camp foreman and time-keeper also a crew of sixty colored laborers se-lected from the men who had just completed the clearing of the reservoir area

The camp water supply is taken from a six inch drilled well 145 feet deep cased to rock and equipped with a Meyers deep well pump driven by a 6 horse power gasoline engine which will pump a maximum of forty gallons per min ute

In addition there is a tool and repair shop in which are kept all hand tools and repair parts needed for the job There is a power driven grindstone and emery wheel and a small forge so that all tools and equipment can be kept in first class condition

The building of the camp was started Decem ber 1 1927 and completed January 15 1928 but work was suspended several times on ac count of bad roads and weather conditions. However the men engaged in sanitary and mos quito control work began occupying the camp January 1

For transportation two twenty five foot cabin launches each powered with a 4 cylinder 15 horse power Kermath engine and six 15 foot row boats driven by small 4 horse power out board motors were purchased also one light truck for hauling supplies spray oil and other equipment

More efficiently to patrol the reservoir it was divided into four areas and each field man was assigned to a given territory it being his duty to cover every portion of his area every ten days dipping for larvae looking for the winged insects and performing whatever control measures were necessary to destroy such breeding as was found Each man makes a detailed daily report on a printed form of his findings observations and work done that day From these daily reports the man in charge perceives the condition of the reservoir and is enabled to plan the work for the labor crew the following day

Each field man has a fifteen foot row boat propelled by a 4 horse power outboard motor two axes two bush hooks one rake one fork one shovel one five gallon compressed air knapsack sprayer and one Niagara dust gun Larvicides and motor fuel are drawn as needed From April to November each year he is a signed from one to three laborers as required for spraying dusting ditching and other work

After one year s operation the small 15 foot boats powered with outboard motors were found unsatisfactory as they were not seaworthy On windy days they were swamped frequently and on other occasions when the wind increased the lake became so rough that the men were unable to return until late at night It was found that these boats were too small to carry the equipment and supplies necessary for a day s work Consequently in May 1929 they were replaced by larger and faster boats operated with electrically started inboard motors These larger boats are entirely satisfactory and enable the field men to cover their territory faster accompli h more and lose less time in going from one locality to another

The closure of the dam was made November 7 1927 and as the reservoir began to fill the water picked up and floated vast quantities of fine drift such as corn stalks weeds weed seeds leaves small twigs and a considerable amount of logs poles and other heavy drift which was overlooked or not completely burned by the clearing crews The water gradually rose until December 19 1927 when the lake was within four feet of being full After December 19, the water started falling and on April 1, 1928, was down 14 feet when heavy rains over the entire watershed caused the lake to rise to a maximum elevation on April 14, 1928 The wind and wave action gradually worked the debris to the shores where it stranded in some places the drift and flotage was a few feet wide, in others as much as a hundred feet wide

There were great areas of the reservoir where the sprouts, briers weeds and other native growth reached a height of from two to six feet After these areas were cleared, and when the lake filled, there were miles of shore line, especially in the shallow creek sections where the second growth protruded above the water and which in some instances extended from the hore a hundred feet or more Around these sprouts there was a considerable collection of fine drift and flotage which did not reach the shore and prevented any appreciable wave action in that particular place

On January 1, 1928 active control work was started and during the months of January February March and April, 1928 the entire force was engaged in removing piling and burning drift flotage, trash and other debris which had collected along the shores and in cutting the growth along the margin of the water This work was started where the greatest amount of drift had collected close to thickly populated localities al ■ in such areas as were potential breeding places for the Anopheles mosquito

During the first three and a half months of the year the lake gradually fell fourteen feet below its maximum elevation In this period the drift and flotage on approximately 50 per cent of the reservoir was collected and burned along about 170 miles of shore line which comprised approximately 80 per cent of the total amount of drift and flotage which had accumulated

When the lake filled on April 14, 1928, it floated the remaining drift, and within three days it had been drifted along shore by the wind and waves In addition the flood in the first part of April had brought down much more additional drift and flotage

From May 1 throughout the balance of the year 75 per cent of the labor crews with two foremen were engaged entirely in removing drift and flotage from the margin of the lake cutting sprouts and briers along the shore and working in such areas as the daily reports of the field men showed needed immediate attention The remaining 25 per cent of the labor was employed from May 1 to November 1 applying

larvicides and ditching under the direction and supervision of the field men, and after November 1 they were engaged in the removal of drift and flotage and cleaning the margin of the lake

From April to November 1928 there was an excessive amount of rainfall over the watershed Some of those rains were general over a large territory while others were confined to comparatively small areas and on numerous occasions extremely heavy local rains were falling almost entirely within the lake itself During the year there were numerous floods on the river some of which were quite close together

The following tabulation shows the number of days in the months of April to October both inclusive for the years 1928 and 1929 in which rain fell on the lake and the total monthly precipitation also the average minimum and maximum temperatures for each month

	No Days Rain Fall	Total Precip	Temperature Max	Temperature Min
19 8				
April	11	2 84	1	61
May	10	3 96		57
June	9	3 0	8	63
July	6	1 02	91	0
August		3 01	92	69
September	10	1 0	6	60
October	1	2		55
19 9				
April	9	3 37	78	60
May	12	3 51	83	59
June	15	6 15	8	64
July	1	48	8	6
August	6	1 8	[illegible]	67
September	14	1 43	9	63
October	8	33	6	48

Due to the excessive rainfall throughout the entire summer season the production of both Culex and Anopheles larvae was heavy in sections of the lake and its vicinity This with extremely warm weather during the months of July August and September resulted in ideal conditions for the production of mosquitoes and from the standpoint of mosquito control work conditions scarcely could have been worse

On April 25 the first Culex larva and on April 26 the first Anopheles larva was found in the lake and after this date larvae were found in ever increasing numbers until the first week in September when they reached their peak after which they declined until the first heavy frost on October 25

During the latter part of 1928 the upper river and creek sections began showing an increase in production as there were many large flat shallow areas in these sections in some portions of which the water was only a few inches deep and bull rushes cattails arrowheads and other aquatic and semi aquatic growths were getting a foothold Much of this growth was destroyed but new seedings promptly took its place During this year there was applied a total of 4 091 gallons of oil and 1 102½ pounds of dust as larvicides whereas in 1929 there was applied 2 843 gallons of oil and 9 345 pounds of dust

The following tabulations show the quantity of dust Paris green waste oil and kerosene applied as a larvicide each month during the years 1928 and 1929

	19 8 Oil Gals	19 8 Ker Gal	19 8 Total Gal	19 9 Oil Gal	19 9 Ker Gals	19 9 Total Gals
April	65	6	1	180	18	158
May	39	[illegible]	41	3 0	5	405
June	440	38	4 8	415	[illegible]	4 0
July	95	[illegible]	864	F20	50	570
August	600	66	666	5 0	5	[illegible]
September	101	9	1107	450	41	491
October	4 3	7	430	[illegible]	8	107
	3 50	341	4091	603	40	848

The waste oil used was obtained free of cost from filling stations and oil companies in the near by towns and was collected weekly by the camp truck This oil was strained and a sufficient amount of kerosene added to bring it to a suitable consistency

	19 8 Paris Green Lbs	19 8 Dust Lb	19 8 Total Lbs	19 9 Paris Green Lbs	19 9 Dust Lb	19 9 Total Lbs
April	4	5	9	5	100	105
May	3	[illegible]	63	9	1 5	184
June	4	5	9	2	500	52
July	9	1 5	184	[illegible]	15 5	1601
August		1 0	15	10	1 0	57
September	1	4	448	130	600	730
October	5	100	105	[illegible]	1850	1943
	62	10 0	1103	44	8900	9345

In 1926 a large gambusia hatchery was built which supplies large quantities of minnows. During the years 1928 and 1929 the hatchery furnished over two million gambusiae which were placed in the arms of the lake and in many large drainage ditches emptying into the lake in which there was eddy water These gambusiae multiplied and spread rapidly and are very effective in many areas of the lake

On November 1 1928 the labor crew on the lake was reduced and only a sufficient number of men were employed during the winter of 1928 29 to remove accumulations of drift and flotage and to clean certain creek and ditch banks and portions of the shore line

From April to November 1929 the number of laborers employed was 30 per cent less than for the same period of the preceding year Those laborers not employed by the field men in oiling dusting and ditching were engaged in the removal of flotage and drift and the de

struction of cattails, willows, bull rushes and other aquatic growth The number of field men and foremen employed was the same in 1929 as in the preceding year

During 1928 the per acre cost of all control work amounted to $4 37 per year, and in 1929 the cost was reduced to $2 94 per acre it will be further reduced during the year 1930

The reservoir is now over two years old and as a result of the control measures which have been taken the malarial conditions in the terri tory adjacent to the lake have been improved considerably, Anopheline production has shown a decided decline and the people who live near the border of the lake or very close to it have made no complaints of mosquitoes or health con ditions The lake is now used by several thou sand people for fishing, boating, bathing and recreation and instead of being a menace to health it is recognized as a valuable asset to the neighborhood thus indicating that the results of the sanitary work are highly satisfactory

The following is a brief summary of the cost of clearing the reservoirs of five completed by dro electric projects four of which are in North Carolina and one in Tennessee

No 1—High Rock Development On the Yadkin River in Piedmont Section of North Carolina

Shore line 365 miles	
Surface area of reservoir 16 000 acres	
Actual area cleared 9 790 acres	
Total cost of clearing	$807,342 00
Net receipts from sale of timber	129 468 00
Net cost of clearing	$677 874 00
Net cost of clearing per acre	69 00

Clearing of this reservoir was started September 1 1926 and completed January 1 1928

No 2—Narrows Development On the Yadkin River in Piedmont Section of North Carolina

Shore line 75 miles	
Surface area of reservoir 5 600 acres	
Actual area cleared 3 750 acres	
Net cost of clearing	$150 000 00
Net cost of clearing per acre	40 00

No 3—Cheoah Development On Little Tennessee River on Smoky Mountains of Western North Carolina

Shore line 22 miles	
Surface area of reservoir 00 acres	
Actual area cleared 300 acres	
Cost of clearing	$40 967 00
Cost of clearing per acre	136 00

No 4—Santeetlah Development On Cheoah River in Smoky Mountains of Western North Carolina

Shore line 20 miles	
Surface area of reservoir 2 ,50 acres	
Actual area cleared 2 647 acres	
Cost of clearing	$120 968 00
Cost of clearing per acre	45 00

No 5—Calderwood Development On Little Tennessee River in Smoky Mountains of Eastern Tennessee

Shore line 20 miles	
Surface area of reservoir 500 acres	
Actual area cleared 176 acres	
Cost of clearing	$28,344 00
Cost of clearing per acre	159.00

The land in Developments No 1 and No 2 is rolling to flat, with rather wide creek and river bottoms upon which the timber was ex tremely large and dense all of which however was very accessible

The land in Developments Nos 3, 4 and 5 is very rugged mountain land, quite inaccessible side hill work and along a very narrow strip which features contribute to the high cost of clearing

DISCUSSION (*Abstract*)

Dr P M Boldridge Charlotte N C—I think Mr Clark s figures on clearing are entirely too high

The Duke Power Company with which I am con nected is concerned with problems very like those of the Tallassee Power Company of which Mr Clark is Superintendent We have 32 ponds in North and South Carolina These 32 ponds have a total of 140,000 acres of impounded waters. Our clearing taking 8 of the major projects was done at a cost of $20 75 per acre that is the original clearing We have to go over the entire area I think some scheme should be devised by which we can lower pond clearing Up to a few years ago a new concern would go into an area clear up and let the pond fill up in the spring then in the early fall we had malaria and the community protested that there was malaria which it had never had before and the result was usually several hundred thousand dollars in law uits If a company wants to get down and out let public sentiment turn against it When it has a batch of law suits it will go down rapidly Most companies realize this and in the last few years have made every effort to keep their ponds clean and in sanitary condition and see that the laborers who are used in the developments are protected against malaria

I have just jotted down a few figures We com pletely cleared one lake 6 500 acres which is not a large pond 175 miles long original cost $124 635 22 or $19 25 per acre Now it is true that labor on that pond cost $2.00 per day and the labor item is the most important item of this another pond 35 $18 75 another pond 40 $90 022 14 another 3 250 $67 870 $ 0 00 per acre We had one pond fully twenty years ago before we knew anyth ng about pond clearing We cleared about one third of the pond the original clear ing co t twenty years ago $66 000 Five years ago we spent $85 000 more on t It was at that time a men ace to the health of everybody in the community I think that when pow r companies know malaria and know that they mu t help to eliminate it they will get the general sympathy of the e employees and the people living in the areas w ll be better off Mr Clark s fig ures on ponds are mostly san tary work

On our 140 000 acres of impounded water I have

charged up this year a cost of 34 cents per acre That is rock bottom

Mr Clark s concern made a very elaborate malaria survey before impounding the water Eight years ago I filed some records which I believed I would never need Our general attorney called at my office last spring and asked me about certain people livin in this area who were talking about bringing suit for malaria against the company I looked back in my records In this family of seven five gave a history of malaria two years befo e the impoundin project I had not only the personal hi tory but had a record from the fam ly physician All I had to do was to g ve this to the lawyer and when he told their ttorney they had had malaria previously he knew it was useless to bring suit

The pond should be closed in the fall of the year from water It is criminal to mpound a big body of water n the ummer time without anitary conditions E pecially in Carolina all impounded waters will breed mosquitoes *I am a confirmed believer in Paris green* but to the public a mo quito is a mosquito The aver age layman does not know Anopheles or Culex but when he gets malaria it comes from a pond and he gives the company a lot of adverse criticism

We try to educate people and school children We have lantern slides and go to the country schools within 20 or 30 miles of our projects We have ome areas where every ch ld can tell the types of mosquitoes

Dr S R Benedict Birmingham Ala—The first de velopment of the Alabama Power Company resulted in many malaria su ts again t the Company This devel opment was known as Lock 12 and no steps were taken relative to clearing

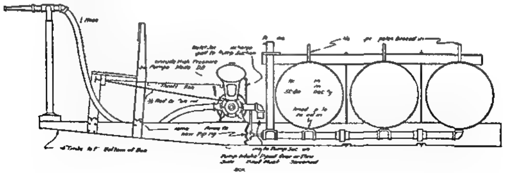
Our next development was Mitchell Dam twelve miles below this first dam on the same r ver the Coosa To prevent a recurrence of these u ts we put in the most extensi e malaria control measures known at that time To begin with we collected evidence in every way poss ble First we had a complete malaria survey made in other words a survey looking into the possibility of malaria among inhab tants of the basin and within a mile radius of the high water These his tories were very carefully taken and on every person living in the basin a blood smear was made and exam ined in our private laboratory at Mitchell Dam

We next went into the question of anopheline breed in around the residences We caught and mounted mosquitoes found in barns and residences, and we went further and made dippings in springs and branches in close proximity to residences taking this water to the laboratory and hatch g different forms of water life pr nc pally wigglers Many of these developed into anopheline mosquitoes and were mounted in the labo ratory The many details of these procedures I will not go nto here Suffice it to say that these mos quitoes were mounted on slides by using water glass and could be put under a microscope at any time for identificat on

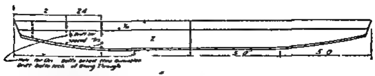
A most elaborate system was put into effect whereby there could be no mistake relative to histories or col lection of other ev dence After the complete histories and other evidence were obta ned all this information was put into large envelopes sealed by the technician and sworn to

Each man who went into the basin to do clearing work was thoroughly examined A blood smear was made and if this proved to be positive or if he had a positive history of malaria he was not allowed to work in the basin at all We did not want it said that we had ntroduced infected men into the basin

We have had numbers of large hydro-electric develop- ments s nce the construction of Mitchell Dam, but the largest is Lake Martin on the Tallapoosa River Here we had a hore line of 720 miles approximately 40 000 acres and we had a different situation from any we had dealt w th before in that Lake Martin is a storage rese vo Our problems here were very different from those at our other developments and were most diffi cult in that the water was raised during the summer mo ths In discussing malaria control on Lake Martin



SIDE VIEW



SIDE VIEW

Alabama Power Company Oil W ter Spray U t

I am going to take the high level mark as it took the lake three years to fill to this point

I frankly think that Mr Clark s figures are too high on his malaria control We have been able to handle the situation at much less expense We had wonderful cooperation from the State Board of Health particularly from Dr S W Welch who in my opinion was one of the greatest health officers that this country has ever seen

Lake Martin was brought up in the summer time a most difficult situation but the question of delay in raising water in the lake backing it up into grasses is one that must be paired against the loss so far as the generation and sale of power is concerned over a period of months

The cost of clearing Lake Martin s basin was approximately $1 500 000 00 and the reclaimed lumber probably amounted to $100 000 00 We pent many thousands of dollars on spraying and one of our most effective methods was the water oil unit which was developed by the Engineering Department of the Alabama Power Company This was original we are sure with the Company as we have been unable to find any records showing that this idea had ever been used before

I believe that the most important single factor in malaria control is the raising and lowering of the water level two to three feet at given intervals It saves thousands and thousands of dollars on labor and oil and gives quicker and better results We have been through the whole gamut of malaria control measures from the gambusia ponds up and down the line and we feel that a well cleared basin with a well kept shore line plus the raising and lowering of the water at regular intervals accomplishes more perhaps than all other procedures combined

Dr L T Coggeshall Chicago Ill—I had control of a lake during the past summer which covered 26 square miles Our clearing costs ran to $1 450 000 00 which averaged $37 00 per acre We started in the pring two years before anything was done to make a malaria survey and the slides that Dr Boldridge spoke of We took blood examinations on about 4 800 individuals which represented 90 per cent of the population living in and near the proposed high water line

Our water was impounded in October 1929 went up during the winter and then this past summer came up very slowly We figured the shore line at 400 miles The lake is only half full when it is finished we will have 585 miles of shore line

For control we use an oil spraying unit which is a little different from that used in other places It worked very satisfactorily We had a large tug boat behind that we had a floating tank with 42 barrels of oil Operations were started on May 17 to control this lake and the tank made 21 circuits of the lake an average of about 8 days for the round trip of the lake We used oil exclusively as the Culicines had to be controlled also

We started using Paris green but because we knew that oil was giving us our control we made only one round trip of Paris green The Paris green was applied by the method of Mr LePrince We went a little further than Mr LePrince We had a generator and had electric lights in our sleeping quarters all summer The oil method is the same as that described by Dr Benedict Oil and water are mixed in a proportion of 1 to 100

Labor for this year consists of three sets of men two men to the boat running these oil bats also a general foreman and an inpector We paid our men 22 cents and 17 cents per hour the man running the boat getting 22 cents and the man that did the spraying 17 cents This of course did not represent the true value of these men but we have a waiting list of 500 willing to step in Labor was $7,00.00 for the summer oil and Paris green $4 000.00 At first, we started out with paraffin oil black oil and kerosene We used that the first three months and the last three months used 50 per cent kerosene and 50 per cent crank case oil that was strained Our sprayings for each trip around the lake cost us $600 00 for the summer Our boats and equipment $11 000.00 maintenance insurance and overhead cost us $2 000 00 In all the cost of this lake was $26 000 00 for the summer Figuring out on a mileage basis the cost was $3 00 per mile for every mile of shore line making the round trip twenty one times

Mr Clark (closing)—Our cost of clearing per acre is based on the acreage actually cleared and not on the total acreage in the reservoir a large portion of which was already cleared and in cultivation If we considered this acreage cost on the entire acreage in the reservoir it would reduce the clearing cost from $69 00 per acre to approximately $40 00 per acre We keep complete and accurate records of all clearing costs We find such records of great value when it is necessary to make estimates on some future contemplated development as it is not only advisable but necessary that any estimates made for such contemplated work be as nearly accurate as possible

Like Dr Boldridge we felt that all the data we could secure pertaining to health conditions within and about this contemplated reservoir prior to the impounding of the water would be extremely valuable consequently did everything possible to induce the State Board of Health to make a thorough mosquito and malarial survey of this area In our opinion such a survey if made by a power company does not have the weight and effect of one made by the State Board of Health People as a rule pay little or no attention to mosquitoes in their vicinity until an artificial reservoir is created after which they are on the watch for mosquitoes and are highly critical of conditions

The cost of control work on this reservoir amounted to $4 57 per acre during the year 1928 or in other words $ 0 000 00 However of this amount $21,000 00 was expended for boats camp and other equipment In 1929 we purchased six additional boats at a cost of $12 000 00

On our Narrows lake located 20 miles down stream from High Rock the cost of control for the year 1929 amounted to $6 500 00 and in 1930 will amount to approximately $4 300 00 This is the lake mentioned by Dr Boldridge where at one time we had approximately a million dollars worth of law suits pertaining to mosquitoes and malaria It is necessary to control the breeding of both Anopheles and Culex mosquitoes from the standpoint of people living adjacent to the lake . Unfortunately both the cities of Salisbury and Lexington discharge raw sewage into our High Rock lake which is unlawful

Dr Benedict states that it greatly simplifies control work to lower the elevation of the lake during the

summer months and that it greatly reduces the cost of such work However water is our stock in trade and *it would be out of the question to expect our Com*pany deliberately to waste ore two or three feet of water during the summer months when ordinarily we are making every effort to conserve it

Dr Benedict further states that for the purpose of *controlling the growth of willows it would be a good* idea to clear the e reservo rs just in advance of the ri ing water This does not always work as no one has any means of telling just how fast the water might rise and in the event of a flood on the river such as *we had in the summers of 1928 and 1929 the water* would r se and fill the reservoir long before clearing operations could be completed We find that willows pring up very fast and that in certain areas which previously were cultivated fields the willows are now *as thick as grass*

We cannot use oil exclusively on account of the large area of very shallow water where boats or tugs cannot navigate

We pay our darkies 25 cents per hour whereas Dr Coggeshall pays his men 17 to 22 cents per hour

We cons der it useless to clear a fifty foot margin around the lake It is a detriment to control work as a tree standing on the margin of the lake will cause no t ouble whereas when you cut these trees down you then have a constant fight a a nst sprouts In our case to clear a strip fifty feet wide around the margin of the lake would amount to 1 00 acres of additional land to be cleared at a co t of $102 000 00 and would do no earthly good so far as we can see Our mainte nance co ts have been materially reduced each year During 19 9 our co t amounted to approximately $45 000 00 whereas this year (1930) it will not exceed $35,000 00

THE MANUFACTURE AND LIFE OF SCREEN WIRE*

By John G Ralston †
Dixon Ill

Wire screen cloth for protection against in sects is *commercially made from two kinds of* wire steel and bronze or copper The wire in both cases is drawn cold through a series of dies from rods in large coils down to the weav ing wire gauges In the process of drawing there are stages at which the wire must be cleaned and annealed to prevent over hardness and to permit drawing to the finer sizes It is interesting to note the amount of reduction by the statement that one foot of steel rod makes five hundred lineal feet of fine weaving wire

The proce s of weaving this wire is similar to the weaving of other fabrics. The warp wire is wound on a large drum which is placed in the loom The wires needed for the width and mesh of screen cloth to be made are threaded through the heddles and reed When the loom is in op eration the filler or cross wire engages the warp wires and is beaten up into position to form the correct spacing After several hundred lineal feet of the fabric have been woven, this strand is cut from the loom and taken to the measur ing inspecting and finishing departments We now have a large roll of bright steel wire cloth which may be finished with a coating of black enamel paint to make the least expensive screen *ing or it may be electro-galvanized or electro* plated with zinc to make the grey dull finish cloth which is a little more expensive than the painted

Black Painted Wire Cloth—The steel wire fabric is run through a bath of paint the sur plus being pressed and blown out to p event filled meshes and is then dried in a heated *tower The preparation of the wire the quality* of the paint the method of application and the degree of coverage all determine the quality or life of this class of screen cloth There is a decided difference between the best and the poorest painted cloth

Electro Gal ani ed Wire Cloth—The process of electro galvanizing with zinc after weaving, *requires very large electrical machines large* tanks for the chemical solutions and a great deal of electric power Generally speaking the process consists of chemical solutions in which are suspended zinc anodes or bars of zinc minute particles from which are passed through the solu tion by the electric current and deposited on the steel wire leaving a uniform layer of chemically pure zinc to protect the wire The repeated im mersion of the fabric or the length of time it remains in the solution serves to build up the zinc deposit to a given standard of quality There are as many different ways of finishing the cloth by this process as there are factories making it and to the unpractised eye the results are more or less the same There may be, how ever a great difference in the character of the zinc deposit which is of greater importance than the quantity of the zinc used and this distin guishes the relative quality of any two or more pieces of screening although to the eye there *may not be an appreciable distinction It is* therefore quite incorrect to assume or to state that one piece of galvanized screening is as good as another The length of service under exposure determine the quality of manufacture.

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*Re d bef N tl l M la l C nmitt e (C fe on Mal (a) m tl e c j i tly with South rn Medical Asse l ti n Tw nty F u th An l M eti g Loui ville K ntucky N mb 11 14 1930

†Pr side t, Rey old Wire Co

Bright Galvanized Wire Cloth—There is another variety of steel wire cloth which was once an important commercial factor, but has been largely supplanted by the electro-galvanized or dull finish screening This is called bright galvanized wire cloth It is made from wires individually galvanized before weaving, by the one coat hot galvanizing process The wires are pulled through a bath of molten zinc wiped off and cooled This wire, with a thin skin of bright zinc is subjected to bending and scraping in the loom Considerable damage is done to the coating, which cracks and flakes off to such an extent as a rule that the steel wire at intersection points is exposed to early rust This bright wire cloth is now more expensive than electro galvanized and does not usually give such satisfactory results

Bronze and Copper Wire Cloth—Bronze and copper wire are drawn and woven into screen cloth much the same as steel wire but when taken from the loom they require no finish So-called pure copper wire makes a soft fabric and not the best quality of screens It is slightly cheaper than copper bronze wire, which is made from an alloy containing 90 per cent copper This has higher tensile strength than copper and makes a fabric that is easier to stretch tightly on creen frames and that is more resilient It will spring back into place after pressure of thumb or hand and holes cannot be punched in it so easily This grade of screening is used by the best class of trade in preference to copper Bronze screening is usually of a bright copper finish but is also furnished in a dark or oxidized color preferred by some architects and builders

STANDARD SIZES

Standard screen cloth is furnished in rolls of 100 lineal feet and in widths from 18 to 48 inches in 2 inch steps or even inch widths Standard meshes are 12, 14 16 and 18 mesh or spaces per inch each way Warehouse stocks over the country consist of any of the following kinds of cloth

Black painted	12 mesh
Galvanized	12 14 16 mesh
Bronze or copper	14 16 mesh

More general use of 16 mesh is recommended for the best protection against insects We are advised by your Committee that nothing coarser than 16 mesh will keep out the Anopheles mosquito and therefore it is of vital interest that manufacturers, jobbers dealers and health officers lay special stress on the use of 16 mesh screening, or 18 mesh when required especially in the malaria sections Care should be taken to see that the screening used is really 16 mesh or 16x16 and not 14 or 15x16 The latter spacing is an indication of poor and inaccurate weaving Since insects will invariably find the largest hole to crawl through, it is important to make sure that 16 mesh protection is really furnished, otherwise 18 mesh might be necessary and this adds to the screening cost

DISTRIBUTION

Wire screen cloth is manufactured in different parts of the country, and is only sold from the factory on a wholesale basis It is distributed through wholesale hardware or jobbing houses and other large merchants, and is sold to the regular millwork companies who manufacture screen frames for windows and doors The wholesale distributors make delivery to the local hardware and building supplies dealer, where the individual may purchase any number of feet required

LIFE OF SCREENS

We are all interested in getting the most for our money and people who screen their homes, while desiring to do so most economically, should not consider the initial cost so much as the average annual cost of the installation A screen which will last without replacement, for five years is much cheaper than a screen which will rust out in one season Yet such variation does exist as between different kinds of screen cloth *which look more or less alike, and for* various reasons, the most important being the difference in manufacture and the irregular conditions of exposure The question is often asked 'How *long will this screen last?' It is impossible* to answer this question correctly, as the life of screening is relative *If* two identical pieces of screening are put on a house, each on a different side one of them may last considerably longer due to the varying conditions of moisture air and wind A piece of screening in a dry climate will last longer than the same piece on the seacoast, or in some manufacturing district where the gases in the air are harmful or near some river or swamp where there is almost continual moisture

Screens that are kept up all the year round and are subjected to all kinds of weather will not last so long as screens that are put up during the insect season and stored in a dry place during the cold weather Screens that have

vines shrubs or trees growing near or against them will not last so long as screens on the open side of a house Under average conditions any screen cloth made from a steel wire sooner or later will rust and its life depends upon the length of time it takes for the weather to break down the protecting coat whether of paint or zinc

There are ways of prolonging the life of screen cloth and the obvious way in the case of black painted screening is from time to time say every year or two to brush over the screen with a light coating of thin black paint so that the meshes will not be filled with it In prolonging the life of electro galvanized cloth perhaps once a year the screen may be brushed over with boiled linseed oil In either case the dust and dirt should first be brushed out

Bronze cloth as well as copper which costs about three times as much as painted and galvanized cloth is not affected by the usual weather conditions to the same extent as steel cloth It does oxidize and at times turns green and causes staining of woodwork for which the *manufacturer never assumes any re ponsibility* since this type of corrosion is inherent in the metal itself While bronze cloth does not rust because it contains no iron nevertheless corrosion takes place producing a green verdigris just as iron produces a red rust In the case of bronze and copper this corrosion starts immediately but progres es slowly Along the sea coast this action is rapidly accelerated by the salt air and combined with the whipping action *of the wind the wires become crystallized* and failure results in a comparatively short time

For high class homes where initial cost is secondary and where convenience is of greater consideration bronze cloth is u ually preferred to steel cloth It is however always subject to failure by abuse and mechanical injury such as *might be caused by a chair* a child or a dog

In conclusion the most practical and economical wire screen cloth for use in anti malaria work is electro-galvanized dull finish cloth 16x 16 mesh and the best quality obtainable This has been proven in tests made by the Government the health department and others

The costs of screening with this class of material are within the reach of any landlord or householder

DISCUSSION (*Abst act*)

Dr L W Hackett —I would like to ask why stainless steel has not been used?

Mr G Watson —It has been used but not commonly because of the cost

Mr Ralston —I would like to answer that question by sayin that it is not always stainless

Dr Hackett —May I ask why it should be so expensive why should it not be used for cloth?

Mr Watson —The cost of sta nless steel makes it out of favor

MALARIA CONTROL ACTIVITIES IN THE UNITED STATES IN WHICH THE INTERNATIONAL HEALTH DIVISION OF THE ROCKEFELLER FOUNDATION COOPERATED DURING 1930*

By JOHN A FERRELL M D
New York N Y

During 1930 the participation of the International Health Division of the Rockefeller Foundation in cooperative projects against malaria in the Southern states has been somewhat less than in previous years Only one member of the staff Dr Mark F Boyd has engaged in the work as his chief re ponsibility After conducting stations for field studies regarding malaria in Brazil southwestern Georgia and eastern North Carolina he began to serve in Mississippi in the spring of 1929 as a member of the staff of the State Board of Health with the title of malariologist During the past two malaria easons he has experimented with the possibilities of integrating practical measures for malaria control with other local health activities undertaken by the various county boards of health

Malaria surveys were conducted in a number of Mississippi counties The anti malaria measures in the counties in the main involved minor drainage and the screening of homes The International Health Division s financial aid in Mississippi is toward a Central Administration budget and limited aid to county budgets in Hinds Pearl River and Holmes counties Assistance to the Central Administration items either for medical epidemiologists or sanitary engineers to engage in malaria control measures has also been granted to Georgia Louisiana South Carolina and Virginia Although it is expected that the county health organization programs will include malaria wherever this disea e is important special grants

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

in addition to those mentioned for Mississippi have been made during 1930 specifically for malaria work to Washington County Georgia Florence County, South Carolina Henrico County, Virginia and the following health districts in Virginia Southampton Sussex, Norfolk Princess Anne Northampton Accomac and Brunswick Greensville

The administrative and statistical staffs of the New York office of the Division made a study of the malaria mortality in the various Southern states over a period of years, and the data have been made available to the various state departments of health of the South and other interested agencies represented at the National Malaria Committee meeting at Louisville

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MALARIA CONTROL IN ALABAMA*

By J N Baker, M D †
Montgomery, Ala

Alabama during 1929 experienced a very high incidence of malaria and there were a total of 430 deaths attributed to this cause This high incidence was reflected during the early months of 1930 by an unusually large number of relapses The extremely dry weather this summer however, reduced the breeding areas and as a result there has been a marked falling off in cases August September and October having only about 27 per cent of the number of cases reported during the same period of 1929

The activities of the State towards control have been conducted along the following lines

(1) The control of impounded water areas is a function of the Bureau of Engineering The actual work is conducted by the various companies, but reports are made weekly as to work done and the amount of breeding going on Periodic inspections are made by State engineers The larger impounded areas have given little trouble but some of the smaller pleasure ponds have been difficult to supervise and maintain as a non menace

(2) In the various county health departments much of the control work is conducted by the sanitary inspector under the supervision of the county health officer During 1929, the State gave a one week course in practical malaria control to fifty such inspectors and to three of its county health officers from counties having the greatest problems This course included lectures and demonstrations of oiling, Paris green ditching (dynamite) and screening It also included a survey of a malaria focus

(3) Urban mosquito control in the organized counties is usually under the direction of the county health department

(4) In three counties during this year a county wide screening program was instituted In each of these the State furnished a full time inspector to assist the county health department with the program In addition the services of three engineers have been devoted to the initiation of this work Whereas only about seventy five homes have been screened in these three counties to date the foundation has been laid for a further and more intensive prosecution of this program next year

(5) An educational program has been launched Included in this is the use of films of local activities particularly screening

(6) Drainage has been encouraged whenever feasible and at the present time one $45 000 00 drainage ditch is under way When completed this project will relieve a considerable population in the vicinity of Montgomery Several lesser projects have been completed

(7) As an experiment plasmochin compound has been used in two circumscribed areas using similar areas as controls Blood surveys were conducted at the beginning of the experiment and repeated at the end of October While results are not available it is planned to submit later a somewhat detailed study of these surveys together with such conclusions as may seem warranted

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†Health Officer State of Alabama

MALARIA CONTROL ACTIVITIES IN ARKANSAS DURING 1930*

By J F GARRISON †
Little Rock, Ark

Malaria and mosquito control activities under the general supervision of the State Board of Health were conducted by 26 cities and four agricultural schools having a total population of 202 500 in a total controlled area of 116 square miles Final financial statements for all of the controlled areas are not available although 18 of the 26 towns reported a total expenditure of $26 337 07 equivalent to 15c per capita Generally speaking this per capita expenditure is too small to assure satisfactory work in all communities particularly the small ones where local conditions present rather large mileage of streams

Although the most intensive control work was conducted in urban areas a large percentage of the rural population was aided by full time county health units in providing measures which have undoubtedly reduced the incidence of the disease in the counties having this service

The Mississippi County Health Unit cooperating with the St Louis Southwestern Railway and with the assistance of Dr Coogle U S P H S made a survey of a large rural area A summary of this survey which included 27 rural schools follows

Number of families	954
Number of persons	5 06
Number showing history of chills and fever in 1930 or 1929	1393
Number of houses screened	548
Number of windows screened	406

A screen door factory was established for the purpose of making the Coogle type of screen door Operations at this factory began in April The making and distribution of screen doors was discontinued on the last of June Up to this time 112 houses had been screened requiring 236 screen doors and the screening of 412 windows It is felt that this project was excellently planned and would bring about a large measure of protection in an area where the malaria rate was known to be extremely high Unfortunately, financial support for the project was withdrawn before it could be completed

Screening has been recognized in Arkansas as an effective measure against malaria where it has effectively been done and efforts have been made during the past three years to extend this type of protection to a larger number of people During 1927 28 following the flood a large number of homes in the State were efficiently screened which was made possible by the assistance of the Red Cross with the cooperation of the U S P H S While no detailed follow up check has been made of the screening done at this time general observations indicate that it has had a most wholesome influence in that homes actually screened have maintained this protection

The year 1928 was an unusually high malaria year in Arkansas showing 181 more deaths from malaria than the year 1926 Nineteen twenty nine showed a reduction over 1928 of 209 deaths or 24 per cent

*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†Director Division of Malaria Control State Board of Health

MALARIA CONTROL IN GEORGIA FOR 1930*

By L M CLARKSON †
Atlanta Ga

The year 1930 has been a year of exceptional progress in malaria control chiefly in drainage promotion Until 1928 there was practically no drainage of consequence for malaria control The extremely high malaria incidence experienced in 1928 and 1929 together with concerted efforts in promotion on the part of the State Board of Health brought about a state wide interest in malaria control by drainage Today there are in the State twenty four counties in which drainage for malaria control has been promoted The size and importance of these projects range from single ponds for community control to county wide drainage Some of these counties have made definite annual appropriations for county drainage systems Some counties have obtained drainage machinery for coun

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†Director Division of Sanitary Engineering State Board of Health

ty wide drainage systems and others are now considering such plans for next year

Control of hydro electric impounded areas still constitutes one of our chief lines of activities We have in the State approximately thirty six hydro-electric impounded areas comprising approximately 150 000 acres Nearly half of these are of recent development and operating under permits issued by the State Board of Health These permits require first complete clearing of all vegetation before the water is impounded and larvicidal control after the water is raised to the maximum elevation The power companies today are working in complete cooperation with the State Board of Health We feel that the crisis has been passed in difficulties of obtaining cooperation from hydro electric companies The paramount problem now is the great number and large areas of hydro-electric impounded areas necessitating a great amount of time from our engineering personnel

Community and town malaria control has been well established by the use of larvicides and by the method of drainage and today malaria as the result of such work is a rural problem We find that municipal administrators are educated to the great economic value of malaria control for insurance of industrial expansion There has been a decided stimulus in malaria work in counties with full time county health officers The need for malaria control in counties has resulted in establishment of county health units In many instances valuable malaria control projects have resulted from joint promotion by cooperation between the county health officer and the State Board of Health

In conclusion it may be stated that expansion of activities has not been without beneficial results as our records show that for the year 1930 to October 1 according to mortality reporting there has been a decrease of 26 7 per cent over the previous year, 1929 We must admit that seasonal rainfall variations have a marked effect upon our malaria incidence but the deficiency of rainfall during the season of 1930 in our section was by no means exceptional as was the case in some drouth stricken states When we consider effective drainage and other methods of control around concentrated populations there can be no argument against such work as far reaching in reducing the number of cases and also deaths

MALARIA CONTROL IN MISSISSIPPI IN 1930*

By MARK F BOYD M D,†
Jackson, Miss

The program developed in 1929 has been extended to the eleven Delta counties having whole time health departments in all of which it is operating to a varying degree This program neither features malaria control nor does it contemplate a 'campaign' of brief duration It is designed with due regard to the limitations of county health departments in personnel and funds their obligation to engage in general health work and the probability that few, if any, could secure special appropriation for this activity Thus the control measures promoted must be those which can be financed by those benefitted This program comprises the following activities namely

(a) Encouraging physicians to greater precision in making diagnoses of malaria

(b) Adoption of a regulation by the State Board of Health requiring physicians to report cases of malaria individually, by name and place of residence

(c) Requiring county health officers to keep a malaria spot map on which all cases are located at their place of residence

(d) Preparing educational material some of which is especially designed to reach the negroes

(e) Promoting minor drainage

(f) Promoting the screening and mosquito proofing of all homes

The following progress has been made with this program

(1) *Malaria Diagnoses*—Physicians are supplied gratis with diagnostic outfits for the transmission of blood specimens to the State Hygienic Laboratory and county health department laboratories All suitable opportunities are used to urge physicians to use a malaria diagnosis with greater precision that is as meaning an infection with malaria plasmodia In 1929 9 2 per cent of deaths reported from the State as due to malaria had been confirmed by microscopic examination In the first eight months of

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†Director Bureau Malaria Control State Board of Health

1930 16 2 per cent were reported as having been confirmed In the first nine months of 1929 806 diagnostic specimens were submitted to the State Hygienic Laboratory from eleven Delta counties In the same period of 1930 there were received 1 439 specimens

(2) *Morbidity Reporting*—In December 1929 the State Board of Health created a special malaria morbidity reporting district including all of the counties lying in the Delta wholly or in part, and having whole time health departments in which district malaria cases are reportable to the health department individually by name and place of residence In order to make this requirement less burdensome to physicians laboratory specimens when positive are accepted *in lieu* of reports when accompanied by sufficient data We regard this as a measure to be achieved by educational means rather than by coercion It must be recognized that in the Delta region a physician will probably have more cases of malaria to report than of other reportable diseases neither can failure to report a case of malaria be justly regarded in the same light as failure to report a case of some other diseases smallpox for example

(3) *Malaria Spot Maps*—Surveys repeated annually are the most accurate means of recognizing local endemic areas as well as following the annual fluctuations in malaria incidence However considering the manifold responsibilities of our health units the prosecution of recurring annual surveys would expend all of the time which the unit might reasonably allocate to malaria Other means must be employed to reveal the endemic foci to the health department A knowledge of the places where malaria occurs is the minimal essential information the health department requires to intelligently develop the control program This is afforded by maintaining a spot map upon which is accurately placed a mark or pin representing the place of residence of every case of malaria reported The old system of reporting malaria neither individualized the malaria cases nor revealed the place of residence Health officers were mystified and the data could not be practically utilized We find that the spot maps interest most of the health officers and they rapidly find they acquire a clearer knowledge of where their local malaria problems occur

(4) *Educating the Negro*—We have been convinced that in our Delta section as in many similar sections of the South the education of the negro is the key to the malaria problem. It was also our conviction that progress in this direction require special preparations We have found the colored posters prepared and distributed by the special committee of screen wire manufacturers of great value and are anxious that they continue this valuable assistance Large numbers of these have been placed throughout the Delta in country stores negro schools and churches and railroad waiting rooms

In order to make visual education most effective in reaching the negro changes were made in a copy of a 16 mm edition of the Rockefeller Foundation malaria film This in the original has scattered human interest scenes illustrating the effect of malaria on a poor white tenant farmer With the cooperation of the negro teachers at the negro school at Mount Bayou similar scenes were enacted with negro actors and substituted in the film We find that negro audiences wax enthusiastic over these scenes and the health departments receive many requests for exhibitions Exhibition in remote rural sections is facilitated by a Kodascope projector illumination for which is provided by an automobile storage battery The health officer has found that the negro midwives render valuable assistance in organizing these meetings These exhibitions serve a very useful purpose in stimulating a demand for screening

(5) *Promoting Minor Drainage*—We are extending as rapidly as possible part time engineering service to county health departments. This is effected by the creation of districts each including three whole-time departments to which an engineer is assigned who as a member of the department staff spends every third week in a county giving lines and levels for minor drainage to municipalities and planters without charge The work is very popular and in each county there is frequently a waiting list of applicants We now have two such districts The accomplishments in this direction are summarized below

MILES OF MINOR DRAINAGE PROMOTED BY COUNTY HEALTH DEPARTMENTS

Eight Months Ending October 1 1930

	S	Const.
Coahoma County	41 6	14 3
Bolivar County	44 7	14
Sunflower County	49 6	9 64
Washington County	6 1	1 2
Sharkey County	6	
Humphreys County	0	
Total	142 6	39 19

Service in this district only available since August 8 1930

The reports of the work constructed are in complete, as planters are not obliged to report the completion However, the 37 9 miles of ditches reported from the first district drained 1 804 acres and were installed by the planters and municipalities at a total cost of $20,341 85

(6) *Promotion of Screening*—The results in the first year s promotion of screening are regarded as very satisfactory Seven counties participated The distribution of the Public Health Service or standard type of door in the twelve months ending June 30 is summarized below

Counties	Houses Screened	Doors Installed	Doors M f d by: Commercial Mft.	Planter	Local Dealer
Bolivar	4 8	1 09	882	887	
Coahoma	5	5 6			5 6
L fl e	329	98	30	8	
Sharkey	Not rep	1277	1277		

Incomplete report

A total of 4 737 of these doors were distributed during the year and probably 2 000 houses have been screened In general we have found the commercialization of their manufacture satisfactory although some trouble has been experienced from a tendency for the manufacturers to depart from specifications The problem faced by different counties is unequal yet it is encouraging to note that in Sharkey County about one third of the rural houses were screened this year if there be included good installations not of the standard type

We have not made the progress we should like in supplementing the screening with papering It is likely that cold weather rather than fear of mosquitoes will be our greatest aid in securing its extension

(7) *Malaria Incidence*—The influence of the great drought of 1930 was felt in all parts of the State Malaria cases and malaria deaths were reported as follows in 1928 and 1929

	19 8		19 9	
Region	Case	D ath	Ca es	D aths
Delta	33 24	41	2722	128
Bluff	1684	111	1 660	6
Northeast	31724	114	314F5	3
South central	16584	5	15997	46
Coast	506	3	701	7
	98885	5 1	91045	316

Excepting in the coastal region and adjacent parts of the south central region, the upward trend of malaria incidence during recent years was checked in 1929 Available evidence indicates the drought markedly checked the transmission of malaria over most of the State, and it is probably safe to say that the malaria incidence in most parts of the State during 1930 is the lowest known This conclusion is corroborated by the morbidity and mortality reports the results of laboratory examinations, the opinions of practising physicians and the results of surveys

(8) *Outlook*—The experience of the present season has demonstrated the practicability and workability of the foregoing program. The control measures promoted are popular and well received It is possible, however, that in view of the economic outlook for 1931 we may not be able to accomplish as much in 1931 as during 1930 However, it is expected that efforts to extend screening will be redoubled during the coming winter and spring A number of the county health departments are making extensive use of the negro movies Any effort is easier if a definite objective is set, and, in view of the interest known, the slogan Screen every home by 1935 does not appear unreasonable

MALARIA CONTROL WORK IN OKLAHOMA*

By CLYDE W BESON M D,†
and
F R HASSLER ‡
Oklahoma City, Okla

An active malaria control program was started in Oklahoma by the State Health Department in the early spring of 1928 and the complete outline of this program has been presented in the Ninth Annual Report of the *Department* It may be stated briefly as follows

OUTLINE FOR MALARIA CONTROL PROGRAM

(1) Estimate of the amount and location of malaria in the district or county
 (a) From physicians reports
 (b) School census
 (c) Spleen index
 (d) Blood index
 (e) Prepare map of district or county

*Read befor Nat nal Mal ria C mmitt e (Confe n on Mala a) m t ng c nj intly with Southern M dical Assoc ati n Tw nty Fou th An ual Meeting Lou svill Kentu ky November 11 14 1930

†C mmi sioner of Health

‡Assi tant Sanitary Engineer

(2) Educational work
  (a) Newspaper articles
  (b) Bulletins and printed matter in schools
  (c) Printed matter and letters mailed out to rural route box holders and to persons whose names and addresses have been obtained from the school malaria census blanks
  (d) Health talks to schools and community meetings
  (e) Lantern slides and motion pictures

(3) Methods of Control
  (a) Drainage and oiling campaigns for mosquito control in the larger towns and cities
  (b) Quinimization of the malaria cases Standard malaria treatment furnished free to all indigent cases and to school children The establishment of pill drills in the school found to be heavily infected with malaria

This plan has been followed as nearly as local conditions would permit and in counties having full time health units the work has been carried on by the unit In the other counties the work has been done by the State Health Department cooperating with some local organization such as the chamber of commerce or the county superintendent of schools The total expense in these counties has been borne by the State Health Department Unfortunately there are only three counties in the malaria district that have county health units The remainder have only part time health officers

The malaria district includes about twenty counties all of which are in the eastern and southeastern part of the State There are 77 counties in the State This part of the State is hilly or mountainous having many rivers and streams and having the heaviest rainfall of any part of the State There are larger valley areas which are very fertile and in which most of the population lives The principle crop in the section has been cotton, but in recent years the cotton crop has been small due to unfavorable weather conditions and the invasion of certain insects that have destroyed it

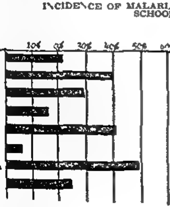
Economic conditions since 1920 have not been good Many banks have failed and a large part of the land has been sold for taxes Very little rural development such as screening of houses or land drainage has been done in fact conditions in this respect are probably worse than they were ten years ago This condition has made it impossible for the counties to contribute toward a malaria control program and has made it necessary to furnish a large amount of free treatment to malaria cases Physicians have moved away from the district leaving many localities without the services of a physician

Malaria surveys have been made by the school census methods and the results of these are given in *Table 1* These surveys have been made by giving an information card to each school child to be filled out by the parent and returned to the teacher Eight counties have been surveyed by this method which represents 4 202 families and 25 190 persons

A large number of blood smears have been

Table 1

INCIDENCE OF MALARIA IN OKLAHOMA COUNTIES
SCHOOL CENSUS



County	No. of families	No. of persons	% pos.
Bryan	856	5 629	22 0
Choctaw	339	2 022	39 9
Coal	453	2 799	29 7
Marshall	280	1 597	16 3
McIntosh	570	3 426	40 4
Love	431	2 376	8 4
Pushmataha	295	1 673	49 0
Sequoyah	576	3 481	34 7

Note —Census made by mailing malaria card to the home from the school. Card was filled out by the parent and returned to the teacher by the student.

The reports of the work constructed are incomplete as planters are not obliged to report the completion However the 379 miles of ditches reported from the first district drained 1,804 acres, and were installed by the planters and municipalities at a total cost of $20 341 85

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Counties	Houses Screened	Doors Installed	Doors Mfd by: Commercial Mft	Doors Mfd by: Planter	Doors Mfd by: Local De ler
Bolivar	438	1 09	[illegible]	887	
Coahoma		5 6			5 6
Leflore	29	88	30	87	
Sharkey	Not rep	1 7	1 7		

Incomplete repo t

A total of 4 737 of these doors were distributed during the year and probably 2 000 houses have been screened In general we have found the commercialization of their manufacture satisfactory, although some trouble has been experienced from a tendency for the manufacturers to depart from specifications The problem faced by different counties is unequal, yet it is encouraging to note that in Sharkey County about one third of the rural houses were screened this year if there be included good installations not of the standard type

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Bluff	1684	111	15660	6
N rtheast	317 4	114	31465	73
South central	16584	62	15997	46
Coa t	606	3	01	7
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By Clyde W Beson, M D,†
and
F R Hassler,‡
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†Commis i ner of Health
‡Assistant Sanitary Engineer

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   (a) Drainage and oiling campaigns for mosquito control in the larger towns and cities
   (b) Quininization of the malaria cases Standard malaria treatment furnished free to all indigent cases and to school children The establishment of pill drills in the schools found to be heavily infected with malaria

This plan has been followed as nearly as local conditions would permit and in counties having full time health units the work has been carried on by the unit In the other counties the work has been done by the State Health Department cooperating with some local organization such as the chamber of commerce or the county superintendent of schools The total expense in these counties has been borne by the State Health Department Unfortunately there are only three counties in the malaria district that have county health units The remainder have only part time health officers

The malaria district includes about twenty counties all of which are in the eastern and southeastern part of the State There are 77 counties in the State This part of the State is hilly or mountainous having many rivers and streams and having the heaviest rainfall of any part of the State There are larger valley areas which are very fertile and in which most of the population lives The principle crop in the section has been cotton but in recent years the cotton crop has been small due to unfavorable weather conditions and the invasion of certain insects that have destroyed it

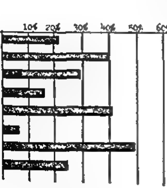
Economic conditions since 1920 have not been good Many banks have failed and a large part of the land has been sold for taxes Very little rural development such as screening of houses or land drainage has been done in fact conditions in this respect are probably worse than they were ten years ago This condition has made it impossible for the counties to contribute toward a malaria control program and has made it necessary to furnish a large amount of free treatment to malaria cases Physicians have moved away from the district leaving many localities without the services of a physician

Malaria surveys have been made by the school census methods and the results of these are given in *Table 1* These surveys have been made by giving an information card to each school child to be filled out by the parent and returned to the teacher Eight counties have been surveyed by this method which represents 4 202 families and 25 190 persons

A large number of blood smears have been

Table 1

INCIDENCE OF MALARIA IN OKLAHOMA COUNTIES
SCHOOL CENSUS



COUNTY	Number of families	Number of persons	% Pos
Bryan	858	5 629	22 0
Choctaw	339	2 022	39 9
Coal	459	2 799	23 7
Marshall	260	1 597	16 3
McIntosh	570	3 426	40 4
Love	431	2 376	8 4
Pushmataha	295	1 673	49 0
Sequoyah	574	3 481	34 7

Note —Census made by distributing malaria card to the home from the school Card was filled out by the parent and returned to the teacher by the student.

made on school children and the results of these examinations show that out of 399 slides 58 positives were obtained or 14 5 per cent positive These slides were taken in the school room on children who said that they had been suffering from chills and fever during the past year

A survey by the spleen index method was made by Dr H P Carr of the International Health Board, in 1926 and the results of this survey are shown in *Table 2* We have been unable to make additional surveys by this method due to the lack of trained personnel It will be seen from the table that Dr Carr estimates an average infection of 23 per cent in the eight counties surveyed by him

The malaria surveys and visits to the schools have shown that our malaria is not confined to certain localities or foci, but that it is pretty well scattered over each county that is infected

This is probably due to three causes the movement of tenant farmers from one farm to another cotton pickers coming from the hill to the valley region to pick cotton and then returning to the hill regions carrying the infection the lack of proper medical attention and of adequate treatment over a period covering six or eight years

Our investigations this year in counties that have had the quininization program for two years have shown that malaria in these counties is now pretty well localized and is of the focal type

It was apparent that the two greatest needs were for an intensive educational program and for the treatment of the cases of malaria already existing

This program was started in that year (1928) in three counties, the educational work being conducted in the schools and at community meetings held at night, lectures and pictures were given on malaria and its importance and control and a large amount of literature was distributed

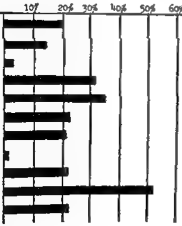
A small portable film strip projector using a storage battery has been used with good success in the one room rural schools

Because of the unfavorable economic conditions the State Health Department began the free distribution of quinine to all indigent cases in these counties This was distributed by the part time county health officers and the local physicians The plan was to furnish treatment only to those who were not able to pay for it and to insist that the full eight weeks treatment be taken However by this method of distribution a large number of persons who were not indigents also received treatment

During the following year 1929 the work was extended to include two additional counties and the quininization of school children was begun in three of the five counties

Table 2

INCIDENCE OF MALARIA IN OKLAHOMA COUNTIES
SPLEEN INDEX



COUNTY	No. of Exam	No. P	% P
Bryan	225	47	0 8
Choctaw	209	41	14 1
Canadian	71	3	4 2
L time	49	16	32 6
L Flo e	113	39	34 5
McCurtai	309	[illegible]	22 0
Mu kogee	77	16	20 8
Muskogee	67	2	2 9
Pitt burg	64	14	21 8
Pitt burg	21	11	52 3
Pushmataha	295	65	22 0

Note —Sur ey made by Dr Henry P Carr of th Inte national Health B ard Examination of school children for enlarg d pleen was method used

Prairie district.

Near impounded reservoir No 3

This program of treatment for school children is carried out as follows the teacher is given the proper instructions and provided with the necessary record blanks and quinine capsules All of the children who are having chills and fever at the time or who say that they have been suffering during the spring and summer are given the treatment The full standard eight weeks treatment is given and the capsules are taken in the school room under the direction of the teacher In many of the larger schools pill drills are organized and are held once or twice a day as the treatment requires

This year (1930) the program includes ten counties and the pill drills in the schools are being conducted at this time in four of these and also in a few of the schools that need the treatment in counties that had the drills last year This treatment of school children has been of great value to the schools as the attendance has increased and the school no longer needs to use one of its rooms for hospital purposes

From May 1 1928 to June 30 1929 650 000 five grain capsules have been distributed and from July 1 1929 to July 1 1930 850 000 capsules and 600 000 capsules will have been distributed by January 1 1931

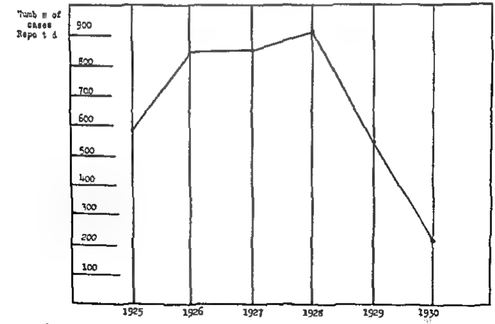
Considerable mosquito control work has been done in the incorporated towns and cities There are only a few larger towns in the malaria district and five of these have carried out mosquito control programs with good results

Because of economic conditions and the absence of previous educational work it has been impossible to do much toward mosquito control in the rural districts and all that has been done is the screening and drainage that the individual tenants or landowners have undertaken However the educational program has brought results and much more will be done when the financial conditions permit

It will be noted from this report that the principal work that has been done and is being done at this time toward control of malaria in Oklahoma is the education of the rural dwellers and the treatment of the already existing cases of malaria Mosquito control work has been

Table 3

INCIDENCE OF MALARIA IN FOUR OKLAHOMA COUNTIES
Cases Reported by Physicians for the Six-Year Period 1925 to 1930 Inclusive
Control Program Started in These Counties in the Summer of 1928 and the Spring of 1929



Note.—Cases reported in 1930 are for the first ten months of the year however very few cases are reported in the last two months of any year
Counties represented are Bryan Choctaw Pushmataha and McIntosh

started and it is planned to start a screening program as soon as it is possible to do so

There has been a great reduction in malaria in the ten counties that have had the control program and additional surveys will be made to determine if possible the extent of this reduction This year has been favorable for the reduction of malaria because of an extremely dry summer following a very hard cold winter

The curve in *Table 3* shows the number of malaria cases in four counties that have been reported by physicians for each year over a six year period The malaria work was started in these counties in the summer of 1928 and spring of 1929 and it will be noted that there is a marked drop in the number of cases reported during the past two years in spite of the fact that there has been much better reporting by physicians during the past two or three years

This drop in the number of cases reported is not due entirely to the control work because the rainfall for this year (1930) has been much below normal as has already been mentioned However we believe that the foundation for malaria control work has been laid in the State

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MALARIA CONTROL ACTIVITIES IN TENNESSEE 1930*

By E L BISHOP M D †
Nashville Tenn

This was the third year of our intensive malaria control program in Tennessee The program, as in previous years included surveys for malaria incidence studies of Anopheles breeding county wide control measures municipal mosquito control and supervision of impounded water projects The State Health Department had the continued support of the Department of Preventive Medicine of Vanderbilt University and of the United States Public Health Service

SCREENING AND MOSQUITO PROOFING OF HOUSES

The county wide screening program inaugurated in 1928 in Lake County was continued this year, and it is estimated that we now have about 85 per cent of the County screened, and over one fourth of the rural houses papered with used cotton sample paper A complete house-to house mosquito proofing survey has been made and is in the process of analysis In connection with this survey, the rural houses in Lake County were all numbered and accurately located on district maps Galvanized sheet iron plates 1x3 inches with numerals punched on them were used We believe Lake County is one of the few counties in the United States to have all its rural houses numbered We can now accurately locate our cases of communicable diseases 'by address " and can positively identify and follow each house as regards screening and other mosquito proofing

In Shelby County the entire staff of sanitary officers was trained in the making of screen doors and in general mosquito-proofing The extreme general drouth considerably impaired the progress of the work but to date 335 houses have been screened and 196 houses have been papered with cotton sample paper

Gibson County has developed a screening program this year in which local lumber merchants are to make the doors and sell them for $2 25 each The hardware and lumber dealers have also agreed not to sell any more wire cloth larger than 16 mesh when their present supplies are exhausted The County Health Department is urging landowners and tenants to take advantage of this cooperation of the merchants and screen their own homes

Milan Humboldt and Memphis have each passed house screening ordinances The Memphis Health Department now has one of its best sanitary officers in training on screening and mosquito proofing

PARIS GREEN DUSTING

Studies of county wide malaria control by dusting with Paris green were continued this year in Dyer County by the sanitary engineers of the United States Public Health Service The results of their work will determine the feasibility of using this measure to control Anopheles breeding in the bottom land of West Tennessee

IMPOUNDED WATER CONTROL

The city of Cookeville raised the water level in its municipally owned power reservoir Proper clearing of the new flooded area was carried out and a power oiling boat was con

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†State Health Officer

structed to control mosquito breeding along the shore lines.

Additional clearing was done at the Rock Island reservoir of the Tennessee Electric Power Company and dusting with Paris green was also employed.

SCHOOL SURVEYS

Blood surveys of all the schools of Lake, Dyer and Lauderdale Counties were made in March of this year and again in August. All the schools in Tipton and Shelby Counties with an incidence last year of over 5 per cent were also surveyed in August as well as selected schools in Obion County. The United States Public Health Service has cooperated largely in the examination of these specimens. The results of the spring surveys showed the usual seasonal decrease over the preceding summer. The results of the summer surveys have not yet been reported.

COMMUNITY SURVEYS

Three communities in Dyer County were surveyed in June and again in September for history, spleen and blood indices and for the mosquito population of the houses. This was done to assist the Public Health Service in evaluating its work with Paris green. Similar surveys were made in four communities in Lake County in August. These showed a considerable decrease in malaria incidence which seems to be due, at least partly, to the screening campaign in Lake County. However the unusual drought this year makes it impossible to be sure to what extent other measures may have assisted in controlling malaria.

USE OF PLASMOCHIN IN COMMUNITIES

In Lauderdale County, two projects were carried out with the use of plasmochin. In the first of these, a vigorous treatment program with quinine and plasmochin was instituted on the Henning Farm with the object of reducing the incidence of malaria to a minimum so that the previous mosquito proofing of the houses could be properly evaluated. This work is being reported for the State Health Department in detail by Dr. Meleney. The second plasmochin project was the administration of small weekly doses of the drug to all members of an isolated community throughout the mosquito breeding season in an attempt to control malaria transmission. This program will have to be continued for one or two years before definite results can be reported.

ROADSIDE BORROW PIT CONTROL

Several years ago, upon our recommendation, the State Highway Department embodied in its specifications a clause requiring that all borrow pits on state road contracts be satisfactorily drained. This year a cooperative arrangement was made with the State Highway Department whereby a sanitary engineer of the State Health Department reports to the Highway Department the location of state highway borrow pits which need draining and the Highway Department does the drainage work. It is believed that efficient drainage can be maintained in this way from year to year. This work is being extended to include county highways as well.

OTHER CONTROL ACTIVITIES

In municipal mosquito control, the State Health Department makes original estimates of cost where needed and makes surveys during the mosquito season for satisfactory progress of the work. Twenty-five of the larger cities and towns and a number of smaller communities did mosquito control work this year, consisting of drainage, oiling and in a few instances Paris green dusting.

TEXAS MALARIA CONTROL ACTIVITIES*

By J. C. ANDERSON, M.D.,†
Austin, Tex.

Mosquito control work with special emphasis placed upon Anopheles eradication is carried on in more than 100 incorporated cities, and the total population so protected is about one million. The work is extended yearly to new towns wherein aid and supervision are given by the field men of the Bureau of Sanitary Engineering. At the town of Jefferson, in Marion County, following flood relief work in 1930, an anti-mosquito campaign was successfully instituted. Work was extended into the country districts where it was confined to the free distribution of quinine to the farming population.

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*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Fourth Annual Meeting, Louisville, Kentucky, November 11-14, 1930.

†State Health Officer.

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There has been a great reduction in malaria in the ten counties that have had the control program and additional surveys will be made to determine if possible the extent of this reduction This year has been favorable for the reduction of malaria because of an extremely dry summer following a very hard cold winter

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†State Health Officer

in the cooperative counties and in the State The deaths in the cooperative counties varied from 12 in 1921 to 1 through September 1930 whereas the deaths in the whole State have varied from 43 in 1921 to 10 through September, 1930

On account of the very low incidence of the disease, malaria activities have been held in abeyance for this year

Table 1

MALARIA INCIDENCE IN COOPERATIVE COUNTIES 1921 1930

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930 Thru Sept
Accomac	200	212	296*	2	2	11	10	1	0	0
Brunswick	57	93	117	57*	0	0	2	6	2	2
Greensville	242*	251	267	98	[illegible]	80	[illegible]	36	[illegible]	6
Henrico	89	70	69*	77	8	38	15	1	0	0
Isle of Wight	08	324	252	165*	109	245	54	96	57	21
Nansemond	177	168*	33	5	16	7	16	10	14	4
Norfolk County	14	5	12	4	0	0	24*	5	1	2
Northampton	226	163	254	90*	0	3	30	1	0	0
Princess Anne	154	72	71*	65	50	24	9*	7	3	4
Southampton	173	204	179	155	184	106*	19	10	[illegible]	15
Total	1540	1562	1550	718	457	516	244	173	124	54
State total	3861	3651	3611	2485	1838	1641	1413	1106	860	555

Asterisks indicate the year health work started in county

Table 2

MALARIA DEATHS IN COOPERATIVE COUNTIES 1921 1930

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930 Thru Sept
Accomac	1	1	0	0	0	0	0	0	2	0
Brunswick	0	1	1	0	0	0	0	0	1	0
Greensville	2	2	0	1	1	2	0	0	0	0
Henrico	0	0	0	0	0	0	0	0	0	0
Isle of Wight	1	2	3	2	0	0	0	0	1	0
Nansemond	2	10	9	5	6	2	1	0	0	0
Norfolk County	1	4	3	2	3	1	2	1	[illegible]	0
Northampton	0	0	1	0	0	1	0	0	0	0
Princess Anne	3	2	[illegible]	0	2	0	0	1	2	0
Southampton	2	0	1	3	2	2	1	0	0	1
Total	12	22	18	13	[illegible]	8	4	2	6	1
State total	43	41	45	35	45	[illegible]	[illegible]	[illegible]	16	10

The reporting of malaria cases to the Department of Health has increased in efficiency, about 200 physicians now reporting regularly In 1929 a total of 16,103 cases were reported, and according to death certificates filed with the Bureau of Vital Statistics malaria caused 237 deaths in Texas in 1929

An encouraging feature of the year's events was the interest manifested by the East Texas Chamber of Commerce through its assistant manager Mr H W Stanley A series of five conferences was held by this organization at various points in the malaria region They were attended by local health officers and other public officials representatives of various organizations and business men These conferences should do much to gain the support needed by the State Department of Health for future malaria control activities

The State Department of Health also held conferences with the ten rural school supervisors of the State Department of Education The conferences were concerned with the teaching of malaria facts The supervisors agreed to encourage the rural school teachers to give at least one lesson on malaria and its control Talks on malaria were given by members of the State Health Department at three teachers institutes In ten counties of east Texas more than 50 000 copies of a leaflet were delivered direct to the rural school teachers for use in teaching malaria facts

A county nurse put on an educational campaign combined with a malaria survey in Gregg County A State nurse prepared an educational display in San Jacinto County in connection with a local celebration Malaria exhibits were displayed at the Convention of the League of Texas Municipalities at the meeting of the Texas Medical Association, and at the Dallas State Fair

For the first time in history the Department was successful in getting malaria statistics published in the newspapers A map of Texas showing the distribution of malaria was also reproduced in the papers and in the magazine of the State Teachers' Association, *The Texas Outlook* It attracted much attention on the part of the public and also from certain members of the Legislature who criticised us for laying bare the facts On the other hand, the publicity drew resolutions of approval from several interested organizations

The malaria control operations now carried on in the cities have not spread as was hoped, to the rural sections We have noted with apprehension lately an increase in malaria in certain rural areas of east Texas Accordingly we are planning to ask the next Legislature for an appropriation of $30 000 to meet this very great need We are also hoping to make some thorough investigations as to the type of work which the situation requires before making the request for funds

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MALARIA IN VIRGINIA*

By H G GRANT M D †
Richmond Va

Malaria has declined to such a low ebb in Virginia that for the time being, it hardly constitutes a disease of any economic significance Below are given two tables which show the trend in cases and deaths from 1921 1930 both in the cooperative counties and in the State as a whole The cooperative counties are situated in the eastern section of the State and represent a population of 238 047

Table 1 shows the incidence of malaria both in the cooperative counties and in the State as a whole The number of cases reported in the cooperative counties has declined from 1 540 in 1921 to 54 through September of 1930 In the State as a whole the number of cases has declined from 3 861 in 1921 to 555 through September 1930

Table 2 shows the deaths from malaria both

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fourth Annual Meeting Louisville Kentucky November 11 14 1930

†Director of Malaria Control State Board of Health

SYMPOSIUM ON MALARIA

Principally Papers and Reports Presented before the National Malaria Committee, meeting conjointly with the Southern Medical Association at its Twenty Fifth Annual Meeting, New Orleans Louisiana, November 18 20, 1931

Part 1 and Part 2 Reprinted from the Southern Medical Journal Journal of the Southern Medical Association Birmingham Alabama Vol XXV No 5 and No 6 May and June 1932 Part 3 appears only in this Reprint

Table of Contents—Symposium on Malaria

SYMPOSIUM ON MALARIA, Part 1*

PROBLEMS IN MALARIA IN HAITI*

By S. S. Cook, M.D.†
Port au Prince, Haiti

In limiting my brief remarks to the problems of a very small part of the Tropics I am fully aware that this is a departure from the usual tenor of a chairman's address. However the situation in Haiti must parallel in many respects that of other independent republics throughout the hot countries of the world. For those of you who have not been so fortunate or perhaps unfortunate as to spend time in these countries I hope to depict to you something of what malaria means to inhabitants of such places and also some of the disappointments and at times heart breaking failures that fall to the lot of those who are attempting to improve health conditions for them.

Records left by the physicians of the French Colonial period indicate a high prevalence of malaria in Haiti during that period. Although the disease was not clearly distinguished from other diseases, notably yellow fever, yet their description of fevers of tertian, double tertian and intermittent forms leave no doubt that malaria was an important factor in mortality and played a large part in hindering the development of the country. In 1801 Captain General LeClerc, brother in law of Napoleon, arrived in Haiti with an army of 25,000 men and a supporting navy. His orders were to conquer the country and reinslave the natives. Six weeks was regarded as ample time to accomplish this task. Within a year and despite large replacements from France his army had become decimated by yellow fever and malaria. In November 1802 he died a victim of yellow fever and malaria, thus ending one of the most complete defeats of an army by disease in all history.

The Island of Haiti is the second largest of the West Indian Islands and lies between Cuba and Porto Rico. Its location is between parallels 17° 39' and 20° north latitude and between meridians 68° 20' and 74° 30' west longitude. The rough horseshoe shape of the Republic of Haiti gives it quite a disproportionate amount of coast line as compared with its area. With its island dependencies it has about 1,000 miles of coast while its total area is only 10,000 square miles. Likened to a piece of paper crumpled in the hand the Republic is made up of one series after another of steep mountain ranges the general direction of which is from east to west. Between the mountains there are wedge shaped valleys and plains. The total area of all of the plains of importance probably does not exceed 2,000 square miles or one fifth of the area of the Republic. It is characteristic of the plains in general that they require irrigation to obtain reliable crops. In some cases this is due to insufficient annual rainfall and in others to an unsuitable distribution throughout the year.

In general the drainage of Haiti is by small swift mountain streams. One of the characteristics of these streams is that they lose much of their water through crevices in the limestone or underlying strata of large gravel before reaching the sea. Some fair size streams disappear entirely during a large part of the year. This characteristic accounts also for the sluggish and intermittent character of some of them in their lower portions and for the occurrence of large numbers of pools and backwashes which are filled with flood water but remain undisturbed between floods. These pools are often sources of abundant breeding of anopheles mosquitoes.

The temperature in Haiti is notable for its remarkable equability. For any given point the range between the maximum and minimum temperature is very small. Except for a few small settlements in the mountains, there is no place where the temperature goes below the minimum required for mosquito breeding. The rainfall is subject to great variations both as regards locality and season. There is no uniform rainy season for the whole island. Within the past two years there have been unusually heavy and unseasonal rains in many parts of the island. In Cayes there has been considerable rainfall almost every month. Cape Haitian witnessed frequent heavy downpours in what is ordinarily the dry season. In and around Gonaives ponds covering hundreds of acres have been formed where there had been none for the previous 15 years. Rainy days, an uncommon occurrence in Haiti, have been observed throughout the island. Dry pasture land within the city limits of Port au Prince has been converted into a boggy seepage area.

There has been no census of population within the past century. Due to many difficulties it would be a highly expensive and almost impossible task. An estimate of 2,000,000 is more generally accepted than any other. There are nine cities with a total estimated population of about 200,000. Thus it is seen that 90 per cent of the population would be designated as rural.

All towns and villages are built on or near streams which has a direct bearing on the incidence of malaria.

Agriculture on a small farm basis is the principal industry of the country. A sugar mill near Port au Prince, a pineapple cannery near Cape Haitian and a

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*Chairman's Address, National Malaria Committee (Conference on Malaria) meeting jointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 18-20, 1931.

From the American Scientific Mission to Haiti.

†Lieutenant Commander, Medical Corps, United States Navy.

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*Part 1 of a Symposium on Malaria reprinted from *Southern Medical Journal*, Journal of the Southern Medical Association, Birmingham, Alabama, May 1932, Volume XXV, Number 5, pages 521-551.

sisal plantation also near Cape Haitian comprise all of the major industrial developments

The peasants largely of African descent live on or near their small farms Their houses have mud walls, dirt floors and thatched roofs Although all windows and doors are clo ed at night pace along the eaves and around the doors permits easy entrance of mosquitoes Living as they do outdoors most of the day and into the night, screening even if it were practicable would be of little benefit Their usual bedtime is shortly after dark and they commence the next day while it is still dark People from the hills come down to the towns for market often spending a part of the night en route Those who live at altitudes where anopheles are not found are thus exposed to malaria Another source of infection is the Saturday night dance or bambosh to which people may travel miles. These dances are held throughout the Republic and are attended by almo t the entire population Beginning at nightfall they frequently last until after daybreak

The oft repeated statement that malaria yaws and intestinal parasites are the chief diseases does not entirely cover the case To these should be added malnutrition In the examination of over 12,000 school children in Port au Prince note was made of those who showed gross evidence of malnutrition The percentage varied from 10 in the high class private schools to as high as 54 in the poorest sections Dental surveys indicate a very high incidence of dental caries a large part of which is attributed to improper diet Experience here indicates that among the natives the incidence of malaria or malarial paroxysms varies inversely as their nutrition The countrymen and also the working class in the city have no regular meal hour They eat when hungry the meal consisting of whatever is available or what may be purchased with the amount of cash which happens to be at hand.

Over a million and a half illiterate superstitious people living as did their primitive African ancestors riddled with disease down trodden by those no less ignorant but far less honest fighting wars of which they knew nothing afraid to tell even their right names such was the pitiable state of the Haitian peasant in 1915

Since 1919 when the National Public Health Service was created by law much has been accomplished Ten modern ho pitals have been built in accessible towns of the Republic Free clinics are held in nearly 150 places where all who apply are treated No longer are the streets cluttered with beggars whose bodies a mass of sores were horrible sights to passersby Gone we hope forever are epidemics of yellow fever and smallpox Greatly diminished are the horrible ravages of yaws whose lesions yield quickly to arsenicals bismuth and mercury But what of malaria? Progress has undoubtedly been made Concentrating activities near centers of population the usual anti mosquito measures have been employed Miles of ditches have been dug street sweepings have been used to fill swampy areas and much Paris green and oil have been applied Quinine has been distributed through health centers, hospitals and rural clinics Information has been propagated through available channels.

Despite strenuous efforts malaria remains an outstanding problem and a long time challenge to the National Government Can malaria be satisfactorily controlled in Haiti? Under existing economic social and political conditions the answer must be in the negative The solution is in some re pects simple in others, highly complicated and difficult

Along with the rest of the world Haiti has uffered severely in the past two years The low price of coffee her chief export has been keenly felt. Haitian coffee has for many years been highly regarded in France Coffee production in some of the French colonies of Africa bids fair to curtail in large measure this outlet Haiti does not at the present moment produce a single commodity essential to world trade Interesting possibilities for future development are cotton corn tobacco cattle raising and fruit growing particularly pineapples and grape fruit

Agricultural enterprises on a plantation basis could if properly managed materially assist in the campaign against malaria Moving the laborers into well sanitated villages with ground for gardens would go a long way toward reducing the incidence of intestinal parasites and would also greatly improve the nutritional status of the people

The educational system leaves much to be desired In the towns and cities there are many good schools throu h which the teaching of hygiene and sanitation can be carried on In the rural districts teaching is highly irregular The teachers are poorly trained and poorly paid Many years must elapse before the country schools can be looked to as distribution centers of health information

With the available statistical data one is unable to say whether malaria is increasing or diminishing in the country as a whole There are no doctors in the rural districts and very few in any of the towns except the ten district centers In the public health hospitals the number of admissions and deaths due to malaria are known This information is of slight statistical value as the proportion of the population from which they came is unknown

The successful control of malaria in Haiti and the same conditions doubt ess apply to many other countries demands first of all an efficient and well managed health department free from political interference Trained sanitary inspectors are scarce and the removal of one for political reasons often leaves no one capable of filling the position

Funds for carrying on drainage and other sanitation projects are of course essential. To obtain them requires cooperation and perseverance The availability of money depends on the economic status of the National treasury and is beyond the control of the Hea th Department Securing of funds from the treasury requires that the Director of the Health Service present

a carefully prepared comprehensive program setting forth his needs in detail. To obtain the information on which to base such a program the Director must be *fully cognizant of conditions* throughout the Republic. Such information may be secured by frequent visits to various parts of the island and through detailed reports sent in by conscientious district public health officer.

Having fulfilled these requirements it now becomes necessary to consider the plan of attack. Experience has definitely shown us that this disease must be approached from two angles, namely, the human carrier and *the insect vector*. *Malaria surveys made by the* Rockefeller Foundation, the United Fruit Company and the National Public Health Service have revealed the island wide distribution of the disease and have also shown its relative intensity. To treat all the carriers of malaria in Haiti is a task *that staggers the imagination*. Such an undertaking could not be accomplished through existing agencies. Even with unlimited funds for drugs and personnel the people have not been educated to the seriousness of the disease and would most certainly defeat the plan through lack of interest and ignorance. However, inability to secure complete success should not deter those in authority from putting forth every effort to alleviate conditions.

Surveys made by the Rockefeller Foundation and the National Public Health Service furnish accurate knowledge as to the life history of the insect vector. *Anopheles albimanus* is, so far as is known, the only efficient vector of malaria and in breeding is capable of adapting itself to an extremely wide range of local natural conditions. Larvae may be found below 2500 feet throughout the island in almost every conceivable type of water deposit. Considering the character, the long with year round favorable temperature and the location of homes near water, one may easily visualize the enormous task which mosquito control presents. In the Southern states of the United States and in many parts of the world anophelines favor certain places for daylight resting. Regular visits to such locations in the vicinity of control operations with recording of the number of anophelines found is a valuable check on the success of the control measures. To date no one has discovered the usual daylight retreat of the *Anopheles albimanus* in Haiti. Without this information one has to rely on evidence of larval infestation of suspected waters.

It would be beyond the scope of this article to outline a plan of action designed to solve the problem which the control of malaria presents. Results obtained in the past ten years indicate the wisdom of the methods employed. Although all of these results cannot be proved by statistics, yet there is sufficient information at hand to conclusively demonstrate a decline in malaria among certain groups of the population and in most of the larger towns and cities. These figures have been published in the Annual Reports of the Director General, National Public Health Service of Haiti, and need not be repeated at this time.

ON ANOPHELES PSEUDOPUNCTIPENNIS AND ITS RELATION TO MALARIA IN MEXICO*

By CARLOS C. HOFFMANN, M.D.
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Of the ten species of Anopheles found in Mexico four only are of practical importance as vectors of malaria in this country. Among the species which have a North American center of distribution only two have to be considered, *A. quadrimaculatus* and *A. crucians*, whereas of the South American fauna *A. albimanus* and *A. pseudopunctipennis* act as vectors. The influence of the two latter species on the development of epidemic outbreaks is preponderant in nearly all malarious *regions of the country*. The same can be said in regard to endemic recrudescences.

Anopheles crucians is found only in the regions of the brackish waters along the Gulf coast. Although it undoubtedly takes part in the transmission of malaria in the states of Tamaulipas and Veracruz about as far south as the port of Tuxpan, its importance in these states lies far behind that of *A. albimanus* which finds ideal conditions for unlimited multiplication in these *regions. Further south I have found A. crucians as an* inhabitant of mangrove districts on the coast of Campeche and Yucatan. It is practically the only species of Anopheles in those parts because the high salt concentration of the breeding places and the complete absence of rivers present conditions *almost prohibitive* for the existence of other species. Since *A. crucians* remains nearly exclusively restricted to the sparsely populated mangrove districts it can play but little part in the periodically appearing epidemics in the harbors of Yucatan.

On the Gulf coast the region permanently infested with *Anopheles quadrimaculatus* extends as far south as Tuxpan. Although I have found this species as far south as the valley of the Papaloapan River its appearance there was always transient and no indication of a permanent settling could be observed. In the central parts of the country *A. quadrimaculatus* reaches considerably more southward infesting abundantly the State of Guanajuato and contiguous regions of Jalisco and Michoacan and extending as far south as to the Valley of Mexico. On the coast its principal time of multiplication is during the winter months exhibiting there as I have already emphasized during other occasions a marked zoophilism. It is more important as a vector in the interior regions of the country where it is found side by side with *A. pseudopunctipennis*. For reasons which will be discussed later it has at present

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to be considered the principal vector of malaria in the capital

Anopheles albimanus exhibits all the characteristics of a species adapted to a hot and moist climate In the Gulf coast it extends from Quintana Roo to the mouth of the Rio Bravo In the regions situated between the southern parts of the state of Taumaulipas and the Champoton River in Campeche it is the most predominant anopheline species and the principal vector of malaria In some localities it is even the only one Within the extensive area it inhabits not only the littoral parts but extends inwards along the basins of the rivers to an altitude of 400 meters penetrating deeper into the valleys of the southern states than it does along the rivers of the north The farther it goes off from the coast or settles in higher altitudes the more it loses its numerical supremacy and epidemiological importance According to its tropical and hygrophile character its principal time of development and vector activity is during the rainy season It suffers an extraordinary reduction everywhere during the dry winter months when it even may disappear completely from certain regions

On the coast of the peninsula of Yucatan where rivers and brooks are absent the living conditions for *A albimanus* are very distinct from those present in the other Gulf states where rivers are plentiful In Yucatan this species is found in isolated parts near the coast where dense forests are absent and where during the rainy season swamps of sweet or lightly salty water are formed Artificially favorable conditions are created here near the villages and ranches by the construction of water deposits used for irrigation drainage or water supply Especially these artificial breeding places constitute in my opinion the main danger for the human settlings in Yucatan and are responsible for the serious outbreaks of epidemic malaria among them The climatic character of the greater part of Yucatan is decidedly unfavorable for malaria and its presence there is possible only through a species of Anopheles which easily adapts itself to artificially created conditions The peninsula of Yucatan is the only part of Mexico where I found the larvae of *A albimanus* within artificial water deposits especially in the tanks used for irrigation of gardens and orchards (Campeche and Merida) *A albimanus* has to be considered as the only species responsible for the epidemics in Yucatan These epidemics as I learned from personal experience are always coincident with an enormous multiplication of this species

Along the Pacific *A albimanus* is found over a large part of the littoral region from Guatemala to the southern districts of the State of Sinaloa but its distribution here is not so regular and its number far less predominant than in the Gulf coast It is found especially during the rainy season exhibiting a decided tendency to distribution over circumscribed areas where conditions for its development are favorable This difference of its distribution in the Gulf states and in those of the Pacific is explained by the dryer climate of the latter It is for the same reason that its zone of activity is nearly exclusively limited to the littoral lowland Only along the Santiago and Balsas Rivers it penetrates deeper into the country

From the survey given on the preceding pages we see that the Nearctic species *A crucians* and *A quadrimaculatus* have a relatively small part in the transmission of malaria in Mexico and that on the other hand the regions of dangerous activity of the southern *Anopheles albimanus* is restricted to well limited areas of the littoral moist and hot lowlands and regions immediately adjacent These regions constitute however only a small part of the endemic zones of malaria which are not limited to the hot and moist country but extend over an enormous area of the central part of the country which is characterized by a more or less dry climate not sparing the high valleys 6 000 to 7 000 feet above sea level In spite of Mexico's being a dry country *par excellence* the control of malaria within its arid regions is of vital importance and causes constant preoccupation to the health authorities The southern parts of the State of Puebla the State of Guerrero Sinaloa and others are malarious zones of prime importance which in their rural districts show a parasitic index of 50 per cent and even more percentages which certainly are not lower than those observed in the hot and moist lowlands of the Gulf states.

The serious infestation with malaria of the interior parts of Mexico can only be understood by the presence of very large numbers of *A pseudopunctipennis* This species is perfectly adapted to dry climates and is decidedly xerophile in all its biological manifestations Among the Mexican species of Anopheles it is the only one which during the excessive dryness of the winter months which prevails over large areas of the south and west of the country does not stop its activity On the contrary the dry season coincides in many parts with the principal period of abundant multiplication of this species For this reason *A pseudopunctipennis* is the principal cause of winter malaria so frequent in Mexico and in the southern and western parts it is the only species which can be made responsible for it during that time of the year

A pseudopunctipennis is found in all parts of Mexico where the essential conditions for its procreation are given It is in clear and pure flowing or stagnant waters especially where the waters contain a flora of green algae Only altitudes over 6 000 to 7 000 feet are free from it as well as the very moist regions of the south and the southeast

In the littoral zone of the Pacific *A pseudopunctipennis* extends along the entire coast from Guatemala to California Its subspecies *franciscanus* McCracken inhabits only the northern part extending as far south as into the northern districts of the State of Sinaloa During the rainy season it enters in competition with *A albimanus* in many parts of the littoral coast districts but while the larvae of *albimanus* are found preferently within permanent stagnant fresh waters and

also within brackish ones the breeding places of *A pseudopunctipennis* are constituted by temporary rain water pools flooded meadows and river banks By the local prevalence of the one or the other of these conditions, the numerical prevalence of *A albimanus* or *A pseudopunctipennis* is decided during the rainy season

In those parts of the west coast of Oaxaca Guerrero Colima Nayarit and many parts of Sinaloa where a decided preponderance of *A albimanus* is observed during the rainy season the number of this species begins to diminish gradually beginning with October whereas *A pseudopunctipennis* appears in ever increasing numbers predominating during the whole dry season until the months of April or May

The high endemic parasitic index which is found practically along the whole littoral zone of the Pacific especially in Nayarit and in the sugar plantations of Sinaloa can therefore be attributed to the activity of both forementioned species The epidemic peaks of estivo autumnal fever however appearing in these regions in December and *during the first months of the* year are principally due to *A pseudopunctipennis* Tropical fever is the most frequent form of malaria along the coast of the Pacific the endemic index of tertian parasites is as a rule higher than that found on *the Gulf coast The parasite of quartan fever I have* found in only a small percentage

Already at a few miles inside of the coast *A albimanus* is found in steadily diminishing numbers also during the rainy season and *A pseudopunctipennis* begins to dominate more and more as one goes farther inside In all the west coast state this species is the only transmitter which has to be considered from a practical point of view within the entire zone which extends between the littoral zone proper and the slopes and valleys of the western mountainous regions Numerous small rivers which rise in the mountains and flow to the Pacific offer adequate breeding conditions On different localities I have observed large quantities of larvae of *A pseudopunctipennis* between stones and small sand bars along the banks of these rivers without the presence of a noticeable vegetation of algae or other aquatic flora

On some southern slopes of the Sierra where during *the summer months abundant rainfall causes the rivers* to rise converting them into rapidly flowing streams adequate breeding places can exist along these rivers during the dry season only all anopheline activities disappear with the onset of the heavy tropical rains These conditions can be observed in the coffee zone of the Sierra of Soconusco in the State of Chiapas where the annual precipitation amounts to 4 7 meters of rain and where a well defined dry season is present It is very significant that *A pseudopunctipennis* a xerophile species has invaded these highly humid regions, but its activity is entirely limited to the dry months and active malaria is observed only during this part of the year

Not infrequently I could observe small foci of endemic malaria in isolated villages of the western mountainous region The people of these villages descend during a certain time of the year to the coast as temporary laborers on the haciendas On account of this malaria was in recent times carried from the sugar plantations situated in the littoral lowlands of Sinaloa into the interior of the State as far as to the limits of the States of Chihuahua and Durango

The whole part of Mexico which is called interior and which is situated between the western range of mountains along the Pacific and the eastern range along the Gulf can properly be divided into three malarious areas all three inhabited by *A pseudopunctipennis* but exhibiting different biological and epidemiological conditions

(1) The southern zone separated from the north by the high transverse volcanic range of mountains comprises the State of Morelos the southern parts of the States of Puebla Mexico and Michoacan and the State of Guerrero Oaxaca and Chiapas

(2) The central zone comprising essentially the States of Hidalgo Queretaro Guanajuato and Jalisco the northern parts of Michoacan and Mexico and the Federal district

(3) The northern zone comprising the dry territory north of the second zone up to the Rio Bravo

The southern zone having an essentially dry climate offers ideal conditions for the life of *A pseudopunctipennis* It is the predominant anopheline species and practically the only transmitter of malaria The high transverse mountain range which separates this zone from the north constitutes the southern limit of distribution for many insects of northern origin and forms also a barrier to the northern anopheline species *Besides A pseudopunctipennis the southern zone harbors* also *A vestitipennis A punctimacula* and *A apicimacula* but the latter three species can practically be neglected as vectors of malaria Their distribution is almost limited to the sylvan regions of the Isthmus of Tehuantepec and Chiapas and to the limitrophe districts of Veracruz

The most malarious regions extend along the rivers the tributaries of which rise in the high mountain and have clear water also during the dry winter months. In these rivers a notable concentration of breeding places of *A pseudopunctipennis* is observed especially within shallow water pools which are more or less cut off from the current owing to the sinking of the river level during the dry season These pools contain nearly always an abundant flora of green algae But even within the free floating parts of the river breeding places of *A pseudopunctipennis* are observed in large masses of green algae which from between the stones extend to the surface of the water During the rainy season the majority of these rivers, and especially their small tributaries, offer much less favorable conditions for larvae On account of the very heavy rains they rise considerably and are transformed into rapidly flowing waters which remove the larvae Besides their

water becomes very muddy and unsuitable for the breeding of *A pseudopunctipennis* For this reason the breeding places disappear during the rainy season more or less completely from the river basins and change to temporary water pools irrigation systems and rice fields

The majority of the villages in the States of Puebla Morelos and Guerrero are situated along rivers. It is easily understood therefore that malaria takes a greater toll among them during the dry winter months with their notable concentration of breeding places along the river banks than during summer when they are scarcer widely separated and farther off from the villages

Tertian fever undoubtedly is the predominant form in the whole southern zone but the proportion between tertian and e tivo autumnal is quite high in many places especially along the whole y tem of the Balsas River According to my ob ervations during the last six years the proportion between tertian and estivo autumnal infections in the valleys of the southern zone is 3 2 In the higher regions of Oaxaca and in the dry anterior of Chiapas the estivo autumnal form is considerably le.s frequent. I am not able to give defi nite information in re pect to quartan fever I found it as a rule in localized circumscribed districts where occasionally the proportion between tertian and quartan attained an index of 3 1

In the central zone the situation in re.pect to malaria is quite different Here with the exception of *A pseudopunctipennis* the southern anopheline pecies are absent their place being taken by the northern species *quadrimaculatus* and *punctipennis* In the central part of the zone with the S ate of Guanajuato as its center between altitudes of 1 600 to 2,200 meters, the two pecies participate as vectors of malaria the one or the other species predominating according to the biological conditions offered by the waters East ward and westward from this center *quadrimaculatus* begins to disappear leaving the field entirely to *pseudo punctipennis* in the malarious regions of Jalisco and the basin of the Lerma River in the west and in the very hot and dry territory of the State of Hidalgo in the east

In the valley of Mexico at an altitude of 2,200 me ters the two pecies are found In the suburbs of the capital and in the surrounding villages *A quadrimacu latus* is found nearly exclusively *A pseudopunctipennis* has retired more and more from the urbanized regions to rural districts which offer more numerous and more adequate breeding places with clear water The pro creation of *A quadrimaculatus* continues uninterrupted during the whole winter in the high Valley of Mexico In the case of *A pseudopunctipennis* one notices a cessa tion of its activity for 4 to six weeks in cold winters in the beginning of the year

In the central zone tertian fever is the most predom inant one and in the higher altitudes it is practically the only form of malaria found Cases of estivo au tumnal are seen very rarely in the Valley of Mexico More frequently they are found in certain parts of Michoacan in the basin of the Lerma River and in the hot country of Hidalgo but the local indices never attain the high proportions found in the southern zone

The northern zone has its own peculiar characteristics. It is excessively dry, semi arid or completely barren and is nearly completely devoid of permanent streams and rivers The majority of these rivers rise in the Sierra but they have water only in their upper part. Reaching the hot and dry plains they sink under the ground and follow a subterranean course forming the so called rios secos (dry rivers) so characteristic of this zone At a first glance it would seem rather im probable that the beds of these rivers which carry waters only after heavy rain and during a short period of the year would constitute one of the most serious problems in respect to malaria in the northern zone The danger arises from filtrations which take place into the beds of many of these dry rivers Very clear waters rise in the beds running for about a hundred yards only to sink under the ground again or more or less permanent pools are formed These waters form ideal breeding places for *A pseudopunctipennis* and *A punctipennis* For *A quadrimaculatus* the region seems to be too dry and the pecies is found only in the bor ders of the zone

A second interesting condition of the zone is the adaptation of *A pseudopunctipennis* to artificial water deposits. I quote in this re.pect especially the city of Monterrey This City suffers frequent epidemic out breaks of malaria coincident with an abundant develop- ment of *A pseudopunctipennis* The search for the cause of this development revealed to me always a very heavy infestation with larvae of *A pseudopuncti pennis* of the filtration water in the dry bed of the Santa Catarina River as well as of the fountains and the tanks in the gardens and patios of the houses It is evident that the control of malaria under such con ditions is relatively easily accomplished by proper methods applied along the river beds and by rigid health board rules in respect to all artificial water de posits which brought prompt relief during our cam paign in 1928

Within the dry northern zone malaria has a far wider distribution than has generally been supposed *A pseudopunctipennis* is practically the only vector of ma laria and a rough estimation of the infection may be obtained from the predominance of the latter species or of *A punct pennis* Villages of the north which show only *A punctipennis* are practically free of malaria. They are generally situated at higher altitudes (Sal tillo etc) Even in the central parts of the most dry and most arid reg ons as for instance in the State of San Luis Potosi and the near by districts of Tamau lipas I found larvae of *A pseudopunctipennis* with certain regularity within isolated natural springs (ojos de agua) and draw wells of the ranches

Tertian malaria predominates absolutely in this

northern zone. During our survey in the interior of the States of Nuevo Leon and Tamaulipas tropical malaria did not even attain 10 per cent of the cases of tertian.

As already mentioned *A. albimanus* predominates in the littoral zone of the Gulf not only numerically but also as a transmitter of malaria. Besides from this species *A. vestitipennis*, *A. pseudopunctipennis*, *A. quadrimaculatus*, *A. crucians*, *A. punctipennis*, *A. punctimacula*, *A. apicimacula*, *A. cruzii* and *A. argyritarsis* are represented. Of the latter species *A. pseudopunctipennis*, *A. crucians* and *A. quadrimaculatus* play the role of transmitters but only a secondary one. The malaria curve rises and falls according to development and abundance of *A. albimanus*.

A. pseudopunctipennis is found in the entire littoral zone north of Veracruz and a short distance south of that City. During summer it disappears nearly completely but reappears in considerable numbers in winter attaining in the northern part of the coast predominance over all the other species. Further south it never attains such high proportions. In the dryer prairies and bush regions between the littoral zone and the slopes of the eastern Sierra it is found more abundantly becoming more important as a vector of malaria. I have never observed *A. pseudopunctipennis* in the region of the large rivers in the northern part of the State of Veracruz, in Tabasco and Campeche and I doubt that it exists there. In the entire zone estivo-autumnal malaria predominates. In the littoral region proper very low indices of tertian cases are found but farther inside their number increases steadily reaching more or less the proportions which we have observed in the southern interior zone.

It is interesting that *A. pseudopunctipennis* has also invaded the villages of Yucatan which are situated inside of the littoral zone. In Merida we found frequently during the dry first months of the year the same water deposits populated by larvae of *A. pseudopunctipennis* which during the rainy season harbor *A. albimanus*, but I do not think that *A. pseudopunctipennis* has at present any decided influence on malaria there.

For an easier orientation I add a chart. I show the seven malarious zones which I distinguish in Mexico. The chart illustrates the species of Anopheles found in each zone, the species which act as transmitters and the form of malaria which predominates. *The chart illustrates very well the enormous importance of A. pseudopunctipennis* as a vector of malaria in the country.

Malaria Zone	Anopheles Found in the Zone	Active Transmitters in the Zone	Predominant Form of Malaria
		A—Littoral of the Pacific	
I. *Littoral zone of the Pacific*	A. pseudopunctipennis A. albimanus	A. pseudopunctipennis A. albimanus	Estivo-autumnal form of fever predominates in high proportions [illegible] than in the Gulf coast
II. Interior zone of the Pacific	A. pseudopunctipennis	A. pseudopunctipennis	Estivo-autumnal and tertian fevers in different proportions as in all the tertian [illegible] predominates
		B—Interior	
III. Southern zone	A. pseudopunctipennis A. *vestitipennis* A. punctimacula A. apicimacula	A. pseudopunctipennis	Tertian form predominates. Percentage between tertian fevers and estivo-autumnal up to 3:2
IV. Central zone	A. pseudopunctipennis A. quadrimaculatus A. punctipennis	A. pseudopunctipennis A. quadrimaculatus	Tertian form predominates. Very slow proportions of estivo-autumnal
V. Northern zone	A. pseudopunctipennis A. punctipennis (A. quadrimaculatus)	A. pseudopunctipennis (A. quadrimaculatus)	Tertian form predominates, estivo-autumnal fever in 10 per cent of tertian cases
		C—Littoral of the Gulf	
VI. Littoral zone of the Gulf	A. albimanus A. pseudopunctipennis A. quadrimaculatus A. crucians A. punctipennis A. vestitipennis A. punctimacula A. apicimacula A. cruzii A. argyritarsis	A. albimanus A. pseudopunctipennis A. quadrimaculatus A. crucians	Estivo-autumnal fever predominant. Tertian form in different proportions high in the [illegible] districts
VII. Zone of Yucatan	A. albimanus A. crucians A. pseudopunctipennis A. vestitipennis A. apicimacula A. punctimacula	A. albimanus A. crucians A. pseudopunctipennis	*Estivo-autumnal fever predominates. Tertian form in* different proportions

DISCUSSION (*Abstract*)

Dr Francisco de P Miranda Mexico City Mexico.—The Republic of Mexico has thirteen different climates. The northwest region has the same climate as California a Mediterranean temperate climate Two chains of mountains divide the Republic in two coastal regions and that of the high plateau in the middle In this elevated portion lies Mexico City and other cities like Puebla more than 7 000 feet above sea level On account of the great altitude there is very little malaria in that part of the country The States of Veracruz and Tabasco are tropical and have the highest malaria incidence In the part where these two mountains unite there is a succession of volcanoes which extend from the Gulf of Mexico to the Pacific Ocean Geographically these volcanoes separate North America from Central America. The State of Chiapas and part of that of Oaxaca have the same climatic conditions as has Guatemala and other Central American countries. The State of Yucatan has the same climate and structure as Cuba

In most of these discussions, malaria in the high plateau is the problem which you do not have in the United States. Beginning with Monterrey and going up to Saltillo the problem is different from the true tropical regions where the *albimanus* has great importance *Pseudopunctipennis* that can live in higher altitudes becomes the most important vector

Dr H C Clark Panama R de P—My experience has been largely confined to the coastal plains of Colombia Panama Costa Rica Honduras Guatemala Cuba Jamaica and Haiti The highlands of Costa Rica and Haiti have revealed the breeding of *A albimanus* at an elevation of 3 000 feet in Costa Rica and at 1 500 feet in Haiti Other mosquitoes are more abundant at these levels but the presence of *A albimanus* even in small numbers should be kept in mind as an important vector Where clean running water is exposed to sunlight and the barrels or troughs collect algae on the bottom and sides *A albimanus* can breed We have found them under such artificial conditions

It is frequently very difficult to correlate the malaria parasite index in a given region with the mosquito flights and data collected from breeding grounds near by We prefer to rely on the dissection of mosquitoes trapped in human habitations

I am surprised to hear that *A pseudopunctipennis* is considered a vector in the high tablelands of Mexico We have this mosquito in the countries I have visited but it seems to breed abundantly only in dry season It bears the reputation of not entering human habitations but we have made large catches in camp quarters of well constructed thatch roof and cane walls in dry season As many as 77 on one visit were caught in a room where three people slept They do not feed on the human being in the vigorous manner noted in experiments with *A albimanus* *A pseudopunctipennis* is a very lazy clumsy feeder and we have never been able to infect it in experiments on human or monkey malaria Others, we know have reported successful feeding results with this mosquito but we do not consider it an important vector in our part of the world

Mr W H W Komp Sanitary Engineer U.S.P.H.S Ancon Canal Zone—The report of *A quadrimaculatus* in the environs of Mexico City is particularly interesting as it does not fit in with our knowledge of the distribution of this species. *Quadrimaculatus* is found as far south as the valley of the Rio Grande at Brownsville but has not been taken further south to my knowledge On the other hand, we should expect *Anopheles maculipennis* a cold water breeder to be found in the mountainous regions of Mexico as I have taken it in Utah and New Mexico at considerable elevation where it was not associated with *A quadrimaculatus* In view of the close similarity of these two species it is possible that Dr Hoffmann may have made an error of identification

Dr D M Molloy Guatemala City—Conditions in the highlands of several of the Central American countries are very similar to those described for certain sections of Mexico in Dr Hoffmann's paper Entomological surveys made in Guatemala during the past year have indicated that *A pseudopunctipennis* is practically the only Anopheles present in the highlands of the interior of Guatemala Malaria is present at an altitude of about 5 000 feet recently appearing in quite sharp outbreaks in the outskirts of Guatemala City In the environs of Guatemala City Anopheles have never been taken in sufficient numbers to account for this malaria except *A pseudopunctipennis* *A albimanus* was recently taken at an altitude of 4 500 feet near Guatemala City What would seem to be a new species of Anopheles closely resembling *A pseudopunctipennis* was recently described by Giaquinto in the Bulletin of the National Health Department of Guatemala. It would appear that this Anopheles is a vector of malaria since it was the only Anopheles taken in a small village about eight miles distant from Guatemala City where a sharp outbreak of malaria occurred In practically all of the highlands of Guatemala *pseudopunctipennis* abounded during last year special climatic conditions existing throughout the entire year the year having been probably the driest which has been known for twenty years As has been found to be the case elsewhere years of exceptionally light rainfall favor the production of Anopheles in the highlands while the reverse is the case when a normal rainfall occurs Very sharp outbreaks of malaria occurred in the towns and villages on the shores of Lake Atitlan 5 200 feet above sea level during last year Extensive anopheles surveys on the shores of the lake failed to reveal the presence of any Anopheles except *pseudopunctipennis* These surveys have been continued during the present year and no other Anopheles has been taken It would therefore appear that *pseudopunctipennis* is the most important vector of malaria in the highlands of Guatemala It has been shown to be the only vector of any importance in certain parts of the Argentine and I can see no reason why this should not hold for the highlands of Central America and Mexico

A albimanus is constantly encroaching on the highlands of Central America It has recently been taken in the immediate vicinity of Guatemala City but not in sufficient numbers to account for the malaria present there In Costa Rica *albimanus* was taken in large numbers in several towns near San Jose and was undoubtedly responsible in large measure for the outbreaks of malaria which occurred in these towns although *pseudopunctipennis* was also present in considerable numbers Everyone knows of course that *A albimanus* is the most important vector in the coastal plains of the American tropics Our experience in the highlands of Central America has convinced me that *pseudopunctipennis* is the most important vector in the highlands of these countries This would seem to be

the case in Mexico where according to Dr Hoffmann *pseudopunctipennis* was the only Anopheles taken in regions between five and seven thousand feet in altitude where malaria is present

Dr M A Barber New York N Y—I have recently had some experience in the Rio Grande Valley of New Mexico where *pseudopunctipennis* and *maculipennis* are the chief species of Anopheles My conclusion as well as that of Mr Komp who worked with me there was that *maculipennis* is the chief vector of malaria in that valley

ANTIMALARIAL VALUE OF CINCHONA ALKALOIDS OTHER THAN QUININE*

By W T Dawson M A †
Galveston Tex

The question may be asked Why should we concern ourselves with the use in malaria of any cinchona alkaloid other than quinine since quinine is certainly 99 9 per cent efficient as a remedy when intelligently and perseveringly used? I shall try to answer that question

Quinine is one of four principal crystallizable alkaloids contained in cinchona barks[1] Of these the first to be discovered was cinchonine in 1810 quinine being isolated ten years later Quinine sulphate is mentioned in the U S Pharmacopoeia edition II 1830 In the third edition 1851 cinchonine sulphate became official and in the sixth (1882) cinchonidine sulphate and quinidine sulphate were added having been definitely distinguished by Pasteur in 1853 There was a very practical reason for these inclusions All sorts of cinchona barks were on the market and all four alkaloids were produced in considerable quantity As all four were reported in medical literature to possess the property of terminating the paroxysms of malaria all four became official It is interesting to go back into the older clinical literature and read some of the evidence upon which our predecessors based their opinion that not one but several cinchona alkaloids were to be considered effective antiperiodics Thus we can find articles on cinchonine sulphate by William Pepper[1] in 1853 and A P Turner[2] in 1864 in the *American Journal of the Medical Sciences* the former considering cinchonine equal to quinine the latter agreeing provided cinchonine were used in slightly larger doses One of the largest scale experiments in comparative therapeutics ever undertaken was that of the Madras Chinchona Commission[3] of 1866 [illegible] in India which tried to compare the antimalarial activity of quinine quinidine cinchonidine and cinchonine of good purity[4] in which 3 617 patients were treated at least 750 with each alkaloid The lowest percentage of cures indicated by cessation of paroxysms was 97 6 with cinchonine and the Commission therefore showed that any of the four common cinchona alkaloids was an excellent antiperiodic The data do not really enable a comparison of the four alkaloids, since almost 90 per cent of the cases treated were quotidian fevers and in the then ignorance of the existence of malarial parasites possibly a few cases of fevers not truly malarial may have been included

An economic revolution in the cinchona trade[5] occurred between 1880 and 1911 and cinchona barks with high content of alkaloids other than quinine have practically disappeared from the markets of the world In 1880 probably 85 per cent of the bark still came from South America[6] and bark in general was relatively much lower in quinine and higher in other alkaloids than now Java was a very minor competitor but under the guidance of Moens[6] was studying quinine production scientifically In 1879 Moens was planting seed from trees which had shown not less than 9 per cent of quinine in the bark[6] against an average of less than 2 per cent in the current bark supplies[5] After 20 years of bitter competition over production and low prices, the less scientifically managed plantations elsewhere had disappeared as competitors and in 1911 Java supplied about 95 per cent of the worlds bark[5] the average quinine content of which had risen to over 3 per cent and is now with Java still far in the lead nearly 5 per cent As the quinine percentage rose the percentage of other alkaloids fell and the production of the latter has decreased to the point where for every seven tons of quinine only about one ton is now produced of the other three alkaloids combined It has become rather unfashionable than incorrect to use these minor alkaloids in the treatment of malaria

Since we have come to know the cause of malaria we have had in the parasite a test object in chemotherapeutic investigation of the subject The comparison of the parasiticidal effects of different cinchona alkaloids has engaged the attention of a number of investigators with varying claims resulting Thus Mac Gilchrist[8] ranked cinchonine above quinine while Giemsa and Werner[9] using smaller doses considered cinchonine much inferior Most observers appear to have thought quinidine equal or superior to quinine and the Malaria Commission of the League of Nations has accepted their practical equivalence[10] Cinchonidine has not been so much investigated perhaps because it is difficult to purify from quinine of which about 10 per cent is ordinarily found as an impurity So far as benign tertian malaria is concerned, the work in India of Sinton[11] who is an honorary member of this Committee led him to conclude that the percentage of relapses is likely to be about the same whichever of the four common alkaloids is used in the course of treatment With cinchonine sulphate costing just now about 40 per cent less than quinine sulphate some use of cinchonine might be advisable in definitely diagnosed *P vivax* infections But the supply available about 30 tons[1] annually is small as compared with the 600 tons of quinine[5] and any extensive demand would

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†Professor of Pharmacology University of Texas School of Medicine

cause a prompt rise in price of cinchonine As regards comparisons of the alkaloids in estivo autumnal infections,[13] quinidine appears to be equal to quinine but cinchonine and cinchonidine are perhaps somewhat inferior in small doses. The statistics are not so extensive as with benign tertian infections, possibly because the investigators in India who have been the most diligent workers in the field appear to have found quinine very highly effective in preventing relapse with rather short courses of treatment much more so than in benign tertian infections.[14] Quartan fevers yield to any of the four alkaloids possibly like benign tertian infections It is evident that for any fair comparison large numbers of patients should be treated with each alkaloid under controlled conditions

There is at least one practical application of the foregoing review In order to grasp it one must recall a little chemistry The four common cinchona alkaloids are really two pairs of optical isomers, quinine and quinidine forming one pair cinchonidine and cinchonine the other[16] Quinine and cinchonidine are levorotatory quinidine and cinchonine are respectively their dextrorotatory isomers In a small proportion of cases of malaria the treatment is complicated by the occurrence of an unusual and intolerable reaction to quinine taking the form of coryza urticaria or even acute dyspneic attacks Evidence[17] is accumulating that a dextrorotatory cinchona alkaloid such as quinidine or cinchonine may in such cases be substituted for quinine and such unpleasant side-effects be thereby avoided. Of these two possible substitutes, quinidine appears to have better endorsements as to its antimalarial activity than cinchonine

Another suggestion that might prove of some practical value is that quinidine might be given a trial in the rare cases of malarial infection which appear to be rather resistant to quinine or to relapse readily

Research upon the chemistry of the four common cinchona alkaloids has shown that each contains as an impurity a hydroalkaloid of very similar chemical physical and physiological properties Thus we may have present in quinine about 2 per cent of hydroquinine[18] in quinidine up to perhaps 30 per cent of hydroquinidine[18] in cinchonine up to 15 per cent of hydrocinchonine and in cinchonidine 8 per cent of hydrocinchonidine[18] The chemical relation is very simple If the common alkaloid be given the abbreviated formula B CH CH_2 that of the corresponding hydroalkaloid[16] becomes B CH CH_3 Hydroquinine[20] and hydroquinidine[9] have both been shown to possess high antimalarial activity Some doubt has, however been cast upon the value of hydrocinchonine[9] in malaria Hydrocinchonidine had apparently not previously been tested. A Texas Louisiana group of medical teachers and practitioners has been interested in testing out the effect of this hydrogenation[16] of the common cinchona alkaloids upon the antimalarial activity We are not yet quite ready to make complete reports But we have records of cases of malaria treated with hydro alkaloids which show that a few days treatment with any one of them is capable of producing disappearance of fever and of parasites This work has some practical importance since Dr Paul Rabe the eminent German chemist has reported (Ber 64 2487) that he has succeeded in the complete synthesis of hydroquinine and hydroquinidine

Including hydrocinchonidine and hydrocinchonine, some sixteen closely related natural or synthetic cinchona alkaloids have now been shown to possess definite antimalarial activity but the results obtained have not been sufficiently promising in the case of any of these to justify urging a general substitution for the time tested quinine of a more expensive substance. A list of all the cinchona alkaloids tested in malaria follows.

Cinchona planting has now almost died out in the Americas despite the fact that Ecuador Peru and Bolivia were the original sources Colombia dominated the cinchona trade in 1880 and shipped to Europe 3 000 tons of bark.[5] Jamaica in the same year shipped a few tons[5] Possibly some Central American or Mexican areas might prove suitable also The elevation should be 1 000 to 5,000 feet the rainfall about 75 to 150 inches per annum[27] In Java good results are obtained[6] on soils of porous structure with much humus and of recent volcanic origin Sample plots of one to ten acres will yield the neces

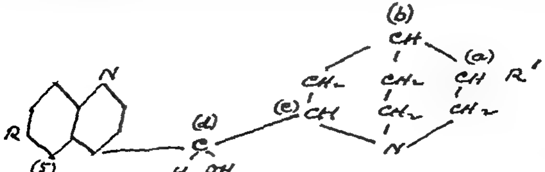

Fig. 1

General formula, cinchona alkaloids. The abod carbon atoms as mm tric, probably dddd in d-isomers below ddll in l isomers[21]

Table I

CINCHONA ALKALOIDS EFFECTIVE IN MALARIA

L-Isomer	Isomer	R	R1
Cinchonidine	Cinchonine	H	CH CH_2
Hydrocinchonidine	Hydrocinchonine	H	CH CH_3
Cupre ne—		HO	CH CH_2
Quinine (methylcupreine)	Quinidine	CH O	CH CH
Ethylcupreine—		C_2H O	CH CH
Propylcupreine[22]		C_3H_7O	CH CH
Hydroqui ine (Methylhydrocupreine)	Hydroquinidine	CH_3O	CH_2CH_3
Ethylhydrocupreine–[3]		C H_5O	CH CH_3
Isopropylhydrocupreine[23]		C_3H_7O	CH CH_3
Isoamylhydrocup eine–[3]		$C_5H_{11}O$	CH CH_3
Aminohydroquinine[24] (NH_2 group at 5)		CH_3O	CH CH_3
Ethylquitenine[24]		CH_3O	COOC H
B Ineffective so far as tested			
Quitenine–[5]		CH_3O	COOH
Quinicine[26]		CH_3O	CH CH_2
(Molecule as of qu nine internally rearranged[16])			

sary data as to desirability in four years of careful cultivation [7]

It would presumably be perfectly poss ble to produce bark with high quinidine cinchonidine or cinchonine yields if desired Thus a variety of C ledgeriana called chin dinifera has shown n recent Dutch analyses nea ly 4 per cent quinidine [7] against 0 2 per cent or less in curre t bark supplies mainly from Java [8] Detail of analy s[7] of chinidinifera ledgeriana bark showed percentage (compa ed with 1929 average commercial bark in brackets) quinine 1 86 (4 935) quinidine 3.86 (0 140) cinchonidine 0 15 (0 384) cinchonine and amorphous 1 81 (0 288 and 1 179)

SUMMARY

Extensive investigations have shown that quinine and quinidine are of practically equal value in malaria and that all four common cinchona alkaloids are of approximat ly equal value in chronic ben gn tertian malaria

In cases of quinine idiosyncrasy taking the form of urticaria coryza or dyspneic attacks quinidine or cinchonine may be given a trial with fair prospects of avoiding the unpleasant side effects and especially in the case of quinidine security as to therapeutic efficacy of the treatment

Prel minary observations indicate that hydrocinchonidine and hydrocinchonine as well as hydroquinine and hydroquinidine possess definite antimalarial activity a result of some theoretical importance

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There is at least one practical application of the foregoing review. In order to grasp it one must recall a little chemistry. The four common cinchona alkaloids are really two pairs of optical isomers quinine and quinidine forming one pair cinchonidine and cinchonine the other[16]. Quinine and cinchonidine are levorotatory quinidine and cinchonine are respectively their dextrorotatory isomers. In a small proportion of cases of malaria the treatment is complicated by the occurrence of an unusual and intolerable reaction to quinine taking the form of coryza urticaria or even acute dyspneic attacks. Evidence[17] is accumulating that a dextrorotatory cinchona alkaloid such as quinidine or cinchonine may in such cases be substituted for quinine and such unpleasant side-effects be thereby avoided. Of these two possible substitutes quinidine appears to have better endorsements as to its antimalarial activity than cinchonine.

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Research upon the chemistry of the four common cinchona alkaloids has shown that each contains as an impurity a hydroalkaloid of very similar chemical physical and physiological properties. Thus we may have present in quinine about 2 per cent of hydroquinine[18] in *quinidine up to perhaps 30 per cent of hydroquinidine*[18] in cinchonine up to 15 per cent of hydrocinchonine[18] and in cinchonidine 8 per cent of hydrocinchonidine[18]. The chemical relation is very simple. If the common alkaloid be given the abbreviated formula B CH CH that of the corresponding hydroalkaloid[18] becomes B CH CH_3. Hydroquinine[9] and hydroquinidine[9] have both been shown to possess high antimalarial activity. Some doubt has however been cast upon the value of hydrocinchonine[9] in malaria. Hydrocinchonidine had apparently not previously been tested. A Texas Louisiana group of medical teachers and practitioners has been interested in testing out the effect of this hydrogenation[16] of the common cinchona alkaloids upon the antimalarial activity. We are not yet quite ready to make complete reports. But we have records of cases of malaria treated with hydroalkaloids which show that a few days treatment with any one of them is capable of producing disappearance of fever and of parasites. This work has some practical importance since Dr Paul Rabe the eminent German chemist has reported (Ber 64 2487) that he has succeeded in the complete synthesis of hydroquinine and hydroquinidine.

Including hydrocinchonidine and hydrocinchonine some sixteen closely related natural or synthetic cinchona alkaloids have now been shown to possess definite antimalarial activity but the results obtained have not been sufficiently promising in the case of any of these to justify urging a general substitution for the time tested quinine of a more expensive substance. A list of all the cinchona alkaloids tested in malaria follows.

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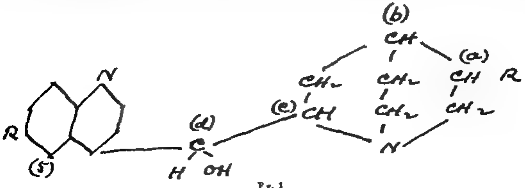

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Gen ral f mula ch na alkalo ds The abcd carbon atoms as mar t e pr bably dddd in d isomers below ddll in l somers[21]

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Hydroquinine	Hydroquinidine	$CH\ O$	$CH\ CH_3$
(Methylhydrocupreine)			
Ethylhydrocupreine[23]		$C\ H_5O$	CH_2CH_3
Isopropylhydrocupreine[3]		C_3H_7O	CH_2CH_3
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Aminohydroquinine[24]		CH_3O	CH_2CH_3
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Ethylquitenine[4]		*CH_3O*	*$COOC\ H_5$*
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Preliminary observations indicate that hydrocinchonidine and hydrocinchonine as well as hydroquinine and hydroquinidine possess definite antimalarial activity a result of some theoretical importance

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21 K g H ld and P lm r Albert D Th Resol ti f T pec A d and th St och m cal Conf gu t f th C h a Alk l ds T ns Chem Soc 121 2578 2586 1922
22 Labo d Grima E t B r Phys l gical d Ther pe ti A t f the Hom logues f Qu in C pre Eth l d P pyl p B ll. de l Acad. de Med 32 25-45 1894
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24 C msa Tw Q ni e D ri t es N tew rthy i Th ra pe t cs Ami o-hydroq thyl-q t ni A h f Schiffs-u Trop Hyg 30 62 (Beih ft) 1926
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cause a prompt rise in price of cinchonine As regards comparisons of the alkaloids in estivo autumnal infections quinidine appears to be equal to quinine but cinchonine and cinchonidine are perhaps somewhat inferior in small doses The statistics are not so extensive as with benign tertian infections possibly because the investigators in India who have been the most diligent workers in the field appear to have found quinine very highly effective in preventing relapse with rather short courses of treatment much more so than in benign tertian infections[14] Quartan fevers yield to any of the four alkaloids[15] possibly like benign tertian infections It is evident that for any fair comparison large numbers of patients should be treated with each alkaloid under controlled conditions

There is at least one practical application of the foregoing review In order to grasp it one must recall a little chemistry The four common cinchona alkaloids are really two pairs of optical isomers, quinine and quinidine forming one pair cinchonidine and cinchonine the other[16] Quinine and cinchonidine are levorotatory quinidine and cinchonine are respectively their dextrorotatory isomers In a small proportion of cases of malaria the treatment is complicated by the occurrence of an unusual and intolerable reaction to quinine taking the form of coryza urticaria or even acute dyspneic attacks Evidence[17] is accumulating that a dextrorotatory cinchona alkaloid such as quinidine or cinchonine may in such cases be substituted for quinine and such unpleasant side-effects be thereby avoided. Of these two possible substitutes quinidine appears to have better endorsements as to its antimalarial activity than cinchonine

Another suggestion that might prove of some practical value is that quinidine might be given a trial in the rare cases of malarial infection which appear to be rather resistant to quinine or to relapse readily

Research upon the chemistry of the four common cinchona alkaloids has shown that each contains as an impurity a hydroalkaloid of very similar chemical physical and physiological properties Thus we may have present in quinine about 2 per cent of hydroquinine in quinidine up to perhaps 30 per cent of hydroquinidine in cinchonine up to 15 per cent of hydrocinchonine[19] and in cinchonidine 8 per cent of hydrocinchonidine[18] The chemical relation is very simple If the common alkaloid is given the abbreviated formula B CH CH_2 that of the corresponding hydroalkaloid[16] becomes B CH CH_3 Hydroquinine[9] and hydroquinidine[9] have both been shown to possess high antimalarial activity Some doubt has, however been cast upon the value of hydrocinchonine[9] in malaria Hydrocinchonidine had apparently not previously been tested A Texas Louisiana group of medical teachers and practitioners has been interested in testing out the effect of this hydrogenation[16] of the common cinchona alkaloids upon the antimalarial activity We are not yet quite ready to make complete reports But we have records of cases of malaria treated with hydroalkaloids which show that a few days treatment with any one of them is capable of producing disappearance of fever and of parasites This work has some practical importance since Dr Paul Rabe the eminent German chemist has reported (Ber 64 2487) that he has succeeded in the complete synthesis of hydroquinine and hydroquinidine

Including hydrocinchonidine and hydrocinchonine some sixteen closely related natural or synthetic cinchona alkaloids have now been shown to possess definite antimalarial activity but the results obtained have not been sufficiently promising in the case of any of these to justify urging a general substitution for the time tested quinine of a more expensive substance A list of all the cinchona alkaloids tested in malaria follows

Cinchona planting has now almost died out in the Americas despite the fact that Ecuador Peru and Bolivia were the original sources Colombia dominated the cinchona trade in 1880 and shipped to Europe 3 000 tons of bark[5] Jamaica in the same year shipped a few tons[5] Possibly some Central American or Mexican areas might prove suitable also The elevation should be 1 000 to 5 000 feet the rain fall about 75 to 180 inches per annum[27] In Java good results are obtained[6] on soils of porous structure with much humus and of recent volcanic origin Sample plots of one to ten acres will yield the neces

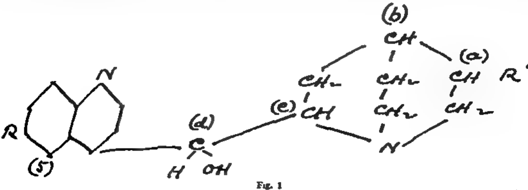

Fig. 1

General formula of cinchona alkaloids The abcd carbon atoms asymmetric probably dddd in d-isomers below ddll in l-isomers

Dr William Krauss—May I not be allowed the suggestion that at one time doctors often gave 60 grains at a single dose? And these doctors and their pupils are not all dead yet.

Prof Dawson—That may account for some of the complaints Possibly the presence of toxic impurities may account for some others Idiosyncrasy cannot be neglected as a factor Extensive and careful observations in India and Italy have shown that cinchonidine and cinchonine possess high antimalarial activity and are not likely to be unduly toxic in 10 grain doses two or three times daily With the present limited production of these other alkaloids as compared with that of quinine they would undoubtedly become very expensive if there were any general demand for them

OBSERVATIONS ON SOME FACTORS ASSOCIATED WITH THE BREEDING OF ANOPHELES MOSQUITOES IN NORTHEASTERN LOUISIANA*

By G H BRADLEY †
Orlando Fla

INTRODUCTION

The fact that in a given locality Anopheles are found breeding in certain water areas and not in others or *sparsely in some areas and abundantly in other* has given rise to a considerable amount of investigation by numerous workers on the causes of this condition The present paper is based on studies made of this problem in the northeastern part of Louisiana in what is known as the Louisiana Delta region The contour of the *land in this region is rather flat accounting for poor* natural drainage and the formation of numerous shallow lakes in the lower areas all of which are to a greater or lesser extent covered by tree growths The streams are known as bayous and are very sluggish having little or no current except after heavy rains and are *usually overgrown with trees and brush except in* such areas as have been cleared of this growth Branches of bayous which have become cut off from the main channel form sloughs which are similar to the bayous except that they remain stagnant throughout the year and usually contain larger quantities of aquatic and *semi aquatic vegetation All these* areas have been found to be Anopheles producers

METHODS OF OBSERVATION

Observations on the occurrence and abundance of Anopheles larvae at selected points in these water areas were made monthly from May to September inclusive during the years 1928 and 1929 The rate of occurrence was *determined on the basis* of the number of larvae taken in a collection of ten dips of surface water the dips being made with an ordinary white enameled water dipper having a diameter of about five inches At the time of each collection the environmental conditions obtaining in the area and the hydrogen ion concentration *of the surface water were recorded A sample of the* top half inch of water was then taken and carried immediately to the laboratory After thorough shaking one cubic centimeter was placed in a counting cell and a count was made of the number and kinds of organisms occurring in 40 cu mm of water as a basis for computing the rate of occurrence of the organisms per c c in the breeding water

Determinations were made of the forms as far as genera whenever possible but those not readily fitting into the keys available were grouped only into classes *The Anopheles larvae collected* were also taken to the laboratory determined as to species and dissections made of some (usually five) of the larger specimens in order to ascertain the nature of the food ingested In only two instances were species other than *quadrimaculatus* found and these were taken from areas where *quadrimaculatus* also occurred. *In these two cases the* gut contents for all species were similar

EFFECT OF TEMPERATURE PRECIPITATION AND QUANTITY OF SURFACE WATER UPON LARVAL RATES

The records of the observations were summarized in various ways In comparing larval rates with temperature precipitation and the quantity of surface water present by months it was found that during 1928 the larval rate rose and fell with the rise and fall of the mean temperature the highest rate coming in August when the mean temperature (82 3 F) was highest In the following year however there were two peaks in the larval rate one in May and the other in September in which months the lowest mean temperatures occurred (72 2 and 75.8 F respectively) It has always been the writer's experience in this locality that the variation in summer temperatures does not noticeably affect larval population as measured by dipping

The summer rainfall in this region is not usually sufficient to keep the water areas from showing a steady decrease as the season advances This gradual decrease tends to keep the margins of the water areas free from vegetation which encroaches on the shore line in times of stationary or rising water and to remove from the surface of the water large quantities of floatage which are blown to the margins and stranded by the wind Except in the case of heavy rains this material is not refloated until the high waters of the ensuing winter return The lowering of the water level also leaves the tree and brush covered marginal areas dry particularly in the lakes and in those lakes the central parts of which are devoid of aquatic vegetation Anopheles production ceases

During 1928 the surface *water decreased very slowly* from May to August large quantities of debris and

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* Read before the [illegible] Malaria Committee (Co[illegible] M[illegible]la[illegible]) [illegible] jointly with the Southern Medical Association Twenty Fifth Annual Meeting, New Orleans, Louisiana, November 18 20 1931

† Bureau of Entomology United States Department of Agriculture.

26. Stephens, J. W. W., and others: Oral Administration of Quinotoxin for Two Consecutive Days Only in Simple Tertian Malaria. Ann. Trop. Med. and Parasitol., 12: 217-222, 1918-1919.
27. Cowan, J. M.: Cinchona in the Empire: Progress and Prospects of Its Cultivation. Empire Forestry Jour., 8: 4-53, 1929.

DISCUSSION (*Abstract*)

Dr. Charles T. Stone, Galveston, Tex.—It has been an interesting and profitable experience to conduct the treatment of patients with malaria in collaboration with Professor Dawson, using various cinchona alkaloids.

My first impression of the probable results of such treatment was that all of the alkaloids except quinine would prove to be relatively inefficient. If they had been effective they would have been at least mentioned in passing in text books on medicine. In the early experiments, in order that no bias in favor of one alkaloid over another might possibly enter into the interpretation of clinical results of treatment, Professor Dawson by my request furnished me with capsules containing an alkaloid marked "A" or "B." Subsequently this precaution was omitted. The drugs were administered to smear positive patients who were having typical paroxysms of chills and fever and who were under careful observation in the hospital. Thus it was possible to note not only the time of cessation of chills and fever but also to observe the day on which the blood smear became plasmodium negative.

The results were quite striking. In all of the alkaloids and hydroalkaloids used so far the paroxysms of chills and fever have been promptly controlled and the smears have become negative for parasites. The average time necessary for the control of active symptoms and ridding the peripheral blood of plasmodia was two to four days. In all of these experiments an amount of the alkaloid equal to approximately ten grains of quinine sulphate was given daily. When the observations were completed, usually at the end of four days, the patients were placed upon ten grains of quinine sulphate daily for eight weeks. This was necessary to conserve the pure alkaloids obtained for experimental purposes for additional cases. The alkaloids studied up to the present time have been cinchonine and quinidine, while hydrocinchonine and hydrocinchonidine were also tried. In every respect the action of all the substances is identical and is comparable to that of quinine.

Perhaps the most important development in connection with the whole study from the clinical standpoint is the fact that those who have atopic reactions to levorotatory quinine may apparently be given the dextrorotatory alkaloids quinidine and cinchonine with safety. We have recently successfully treated a man sensitive to quinine who developed tertian malaria with cinchonine without any difficulty. It had previously been shown that he could also take quinidine without unpleasant effects, while quinine produced marked allergic reaction.

Most of the articles dealing with the therapy of malaria in referring to the treatment of patients who have a so called idiosyncrasy for quinine recommend a host of remedies such as methylene blue, arsphenamine, oil of eucalyptus, atoxyl or sodium cacodylate. All of these substances are at best poor seconds to quinine in their effectiveness in controlling malaria, while quinidine and cinchonine with practically the same therapeutic efficiency as quinine appear to be entirely harmless.

Dr. J. P. Sanders, Casplana, La.—In a small series of cases in which I used hydrocinchonine and hydrocinchonidine in the treatment of malaria I found them to be of definite and positive value. However, I doubt that either is quite so potent as quinine or quinidine.

As to the value of quinidine in cases of idiosyncrasy to quinine I believe there is little doubt. In the September 19, 1931, issue of the *Journal of the American Medical Association* I reported such a case with a complete history. The patient tolerated quinidine without difficulty and responded readily to treatment. In that paper I reported 38 other cases of malaria treated successfully with quinidine.

This year I have been treating a series of cases with quinine and quinidine, trying to prove the value of quinidine relative to quinine. In a series of over 100 cases so far treated, one with quinine and the next with quinidine, I believe, though I have not compiled my results, that quinidine is equal to quinine in its antimalarial value.

I wish to ask Dr. Dawson in what way or by what mechanisms does quinine cure malaria?

Dr. William Krauss, Bolivar, Tenn.—My interest in the pharmacology of cinchona alkaloids dates back fifty years. In 1881 to 1883 I was a student assistant to Caspari at the University of Maryland. When quinine was selling at $5.00 and $6.00 an ounce, cinchonidine was largely used as a substitute because it was one tenth as expensive. About that time, on account of the enormous prevalence of malaria in the South, Congress put quinine on the free list. Prior to that time exhaustive clinical tests seemed to reveal that the order of potency was: quinine, quinidine, cinchonidine and cinchonine. The latter was the basis of the first tasteless chill tonics. Quinidine is the most toxic.

I never will forget the derision with which Laveran's discovery was received at the University of Maryland by the gentlemen of the medical faculty.

Prof. Dawson (closing).—The mechanism of cure of malaria by quinine is, I think, unknown. We must consider various factors. The patient has, as a rule, some natural resistance to the infection, and cure, or at least remission, may occur in the absence of treatment (Boyd: Introduction to Malariology, 1930, p. 23). Kirschbaum (Klin. Wchnschr., 2: 1404, 1923) found tertian parasites incubated 5 to 24 hours with 1:10,000 quinine still infective to paretics, and a daily dosage of 90 grains (about 6 grams) of quinine sulphate produced a blood quinine concentration of only 1:60,000 (Ramsden, Lipkin and Whitley: Ann. Trop. Med. & Parasitol., 12: 42, 1918-1919), so that the action of the ordinary 10 gram dose is probably indirect. Daily dosage of 90 grains is dangerous and does not prevent relapse (Ann. Trop. Med. & Parasitol., 12: 71 and 11: 417), while Osler found doses as small as 1 gram effective in stopping paroxysms in some cases. That other cinchona alkaloids cure malaria is of great scientific interest and must be considered in framing any adequate theory of the mode of action of quinine.

I am not urging that other alkaloids be used, but that quinidine is a possible substitute in some cases of quinine idiosyncrasy or intolerance.

I cannot explain the accusations of undue toxicity against cinchonidine and cinchonine.

algae or other materials which favor mosquito breeding. Reference is frequently seen in literature to the deterrent influence of these surface covering plants on mosquito production and the writer's observations showed that when they form a complete surface mat Anopheles breeding is absent. However this condition is seldom met with and when these plants occur in lesser abundance accompanying conditions are such that good mosquito breeding territory is usually indicated.

Plants such as Castalia, Nelumbo, Saururus and some grasses which root on the bottom and extend to or through the water surface while not of themselves providing much protection serve as attachment and lodging places for protective materials such as algae and debris.

Plants which have large root and stem masses below the water surface and which send shoots above the water sometimes in such profusion as to hide the water surface entirely may or may not indicate good larval breeding areas. In this class are such plants as Jussiaea, knotweed, smartweed and hempweed. Jussiaea for instance by the nature of its growth seems to offer excellent protection for larvae and when only small growths of it are present in an area larvae of all sizes are likely to be found among its algae coated stems and roots. However when an area becomes thickly covered with this material even though conditions in spots appear favorable Anopheles breeding is often very sparse or lacking. While this plant grows luxuriantly under a variety of conditions it shows a particular tendency to grow rapidly and to form a dense covering over the water surface in newly cleared and impounded areas. For some reason this luxuriant growth has not often been observed to persist in the same location for several successive years.

ADAPTABILITY OF LARVAE

Our common Anopheles mosquitoes are undoubtedly very adaptable to a wide variety of breeding places and lacking their preferred habitat they may readily choose another. Because larvae are not found in a certain location therefore there is no reason for believing that conditions in that area are such that they cannot develop there. For example in the course of airplane dusting operations a few years ago it was found that only the shrub and Nelumbo covered marginal areas in a large lake were breeding Anopheles, no larvae being found in the large central area of the lake which was covered with growths of the white water lily (*Castalia odorata*). Both areas had a thick subsurface growth of Ceratophyllum, Potamogeton, Utricularia and algae supplying excellent protection for larvae. A period of drought caused the marginal areas to become dry after which intensive breeding occurred all over the Castalia covered area.

EFFECT OF ENVIRONMENT ON LARVAL RATE

The records on the rates of occurrence of Anopheles larvae in the various environments showed that in places where there was no small debris the larval rates were highest where green filamentous algae occurred either alone or mixed with blue green algae. When blue green algae occurred alone however the larvae were rather scarce indicating that Anopheles mosquitoes avoid these areas to some extent. Areas without filamentous algae of any kind but in which weeds and grass occurred gave substantial breeding rates while very low rates were found where large debris offered the only protection.

In areas in which small debris was present, which material has been previously mentioned as being effective protection for Anopheles larvae, the differences in the breeding rates occurring when algae were present or absent were less noticeable. In both 1928 and 1929 however the areas having a general mixture of debris—grass, algae (both green and blue green) and weeds—showed the highest breeding rates. The deterrent influence of blue green algae on larval abundance when occurring without green algae was also indicated.

RELATION BETWEEN LARVAL RATE AND PLANKTON ABUNDANCE

The counts of food organisms present in all these waters showed an abundance of available food for the larvae and a tendency for the areas with the highest breeding rates to have the lowest plankton rates, a point which has been discussed previously.

In comparing the rates of occurrence per c. c. of the more common plankton genera with the absence of Anopheles larvae and their presence in increasing numbers no definite trends were found, that is the quality of the plankton in the nonbreeding and in the breeding areas having low larval rates was not essentially different from that in those areas having high larval rates.

HYDROGEN ION CONCENTRATION OF BREEDING AND NONBREEDING WATERS

The record of the hydrogen ion concentration showed both breeding and nonbreeding waters to be predominantly alkaline in reaction and to about the same degree. Most of the readings in open impounded areas where no breeding occurred were however somewhat higher than those in the breeding areas, being 8.01 as against 7.42.

RESULTS OF LARVAL DISSECTION STUDIES

The results of the larval dissection studies showed that there was considerable variation among the various organisms in the percentage of times they were found in the larval gut when present in the breeding waters, but they indicated that most of the genera whether those commonly or those rarely present in the breeding waters are liable to ingest on by the larvae. Whether this is by choice or chance is problematical. The amount of maceration undergone by the different organisms while in the mouth of a larva and their varying degrees of digestibility undoubtedly have a great influence on the condition of the material when found

vegetation remained on the water surface and conditions were more or less stable in the breeding areas During this period the larval rate showed a gradual increase A rapid drying of the surface water then occurred from August to September and this stranded the debris and vegetation and caused a decline in the larval rate In 1929 the surface water decreased rapidly from May to August as did the larval abundance From August to September however there was little decrease in the surface water making for a more stable condition in the breeding areas which was accompanied by a rise in the larval rate

It must be emphasized that the effects of seasonal conditions on Anopheles abundance here given are as they occurred under environmental conditions existing in this region during the two years under consideration Under different conditions a lowering water level may increase larval abundance by making large central open areas in shallow lakes suitable for Anopheles breeding One example may be cited of a large lake in which the early spring breeding was entirely marginal The bed of this lake was covered by a rather thick growth of Potamogeton and Chara which early in the season did not reach the surface As the water became shallow the stems and leaves of these plants came to lie at the water surface providing excellent protection for larvae and giving rise to intensive breeding over hundreds of acres of water surface

SEASONAL VARIATION IN ABUNDANCE OF PLANKTON

There was a wide variation in the abundance of plankton organisms in the water during the season but their number seemed to increase as the season advanced and as the water decreased This increase was however very irregular and was caused no doubt by the common phenomenon of periodicity in certain species of organisms

COMPARISON OF LARVAL RATES AND PLANKTON COUNTS

A comparison of organism counts for the two seasons under consideration with larval abundance irrespective of environmental conditions in the water areas indicated a general tendency for the nonbreeding waters to have a higher plankton content than the breeding waters and also for those breeding areas having the highest larval rates to have the lowest plankton rates This was found to be true whether the total plankton or a major class of organisms was considered. However in comparing the plankton abundance in those areas having larval rates up to ten per ten dips with those having greater rates, it was shown that there was really little difference in the average plankton abundance in the two groups

The greater abundance of plankton organisms in the nonbreeding stations can be ascribed to the fact that these stations are usually those in which the water is unshaded or has no aquatic vegetation or debris covering the surface This condition favors more rapid growth and multiplication of chlorophyll containing organisms than occurs in the shaded or partly shaded areas in which most of the Anopheles breeding here about takes place

FACTORS IN LARVAL PROTECTION

The fact that the waters of this locality are well stocked with the top water minnow (*Gambusia affinis* Raf) makes it necessary that protection of some nature be afforded Anopheles larvae before development can take place This condition has been demonstrated by clearing and impounding projects in the vicinity which have eliminated Anopheles breeding Although other factors in addition to lack of vegetation and debris for larval protection may be involved in bringing about this condition in cleared and impounded areas generally it is certain that unless protected from their enemies Anopheles larvae do not develop in numbers in this vicinity

Protection to larvae is afforded in waters in their natural state by floating vegetable debris and by plants which grow in or at the surface of the water in such a manner as to conceal the larvae from their enemies Floating debris can be divided into two classes large debris and small debris The former consists of logs fallen trees sticks leaves and so on which do not tend to form a compact mass on the water surface and do not give very effective protection to the larvae The latter is composed of small particles of rotting vegetable matter resembling coarse sawdust which collect on the water surface to form mats of various sizes and in which the larvae are well protected against their enemies. Floating debris is much affected by wind and by the rising and falling water levels caused by alternating periods of rain and drought In open area and in the absence of vegetation or large debris to serve as anchorage a wind will sweep the smaller material to shore where a lowering water level will shortly strand it until a later rain causes the water to rise. In this manner good larval protection may be alternately present and absent in the same location The same process is in effect with the larger material but to a lesser extent as this material especially the fallen trees and logs tends to become anchored

Of the plants which serve as protection for Anopheles larvae perhaps the most important are the filamentous algae which grow at or just below the surface film of the water Anopheles larvae usually thrive in their presence Ceratophyllum Potamogeton Chara and others of the larger plants which grow in the water and parts of which come to lie at the water surface provide protection in essentially the same manner as the algae Floating plants such as Lemna Heteranthera Wolffia Azolla cannot be considered effective protection for Anopheles larvae on account of the fact that their leaves lie on top of the water surface and therefore do not effectively hide the larvae Patches of such plants however when not too dense usually harbor attached

ANALYSIS OF REPORTS OF 8 354 CASES OF IMPF MALARIA*

By William Krauss M D
Bolivar Tenn

The term impf malaria not used in America has the merit of brevity and of being unequivocally descriptive *Impen* to vaccinate distinguishes from Anopheles malaria

American writers on the subject of malariatherapy are saying very little about malaria the disease as modified by the impf method on the one hand and the pathological individual the paretic on the other In England and on the Continent malariologists have contributed much to the literature of induced malaria and the fatalities have been very much less than in this country Malaria is a disease in which the chief injury lies in the reticulo endothelial system which in paretics has been taxed to the utmost It has been held by Muehlens[14] and Bruetsch[15] that the reaction of the endothelial cells is an important element of the cure

Although perhaps more than 20 000 patients have been treated by this method many are deterred from using it on account of the high mortalities reported and for other reasons In a not inconsiderable experience extending over many years I do not recall ever having had a death from tertian (vivax) malaria While connected with the medical school in Memphis I had occasion to make daily blood examinations on a few cases being treated with impf malaria for general paralysis Since I have been at this institution I have followed the same practice Obviously we cannot ascribe a death to malaria unless we know how heavy an infection we have permitted to develop Without this precaution it is also quite possible to permit a spontaneous intercurrent subtertian infection to be transferred to a recipient I have undertaken by means of a questionnaire to get data upon which a discussion could be based The detailed data of this questionnaire will be discussed *seriatim* under the respective heads

QUESTIONNAIRE

(I) GENERAL INFORMATION

(1) *Number of patients treated?*
(2) Number of malaria deaths?
(3) Method of inoculation?
  a Percentage of takes
  b Seasonal influence
  N B—If more than one method which has been most successful?
(4) Percentage of spontaneous termination of malaria?
(5) Average duration or number of paroxysms?
(6) Method if any for reducing severity of malaria?
(7) Method if any to prevent spread?
(8) Percentage of malarial relapses or chronic malaria?

(II) AS TO FATAL CASES

(1) Ages of patients?
(2) Sex of patients?
(3) Physical condition (treatment risk)
(4) Season of year?
(5) Authenticity of strain (pure vivax)
(6) Number of paroxysms before death?
(7) Ratio of parasites to r [illegible] before death?
(8) What premonitory symptoms of fatal issue?
  (a) Anticipation of paroxysms
  (b) Duplication or diffusion (quotidian or prolonged paroxysms)
  (c) Hyperpyrexia
  (d) Rapid increase of parasites
  (e) Rapid fall of hemoglobin
  (f) Albuminuria
  (g) Bilious vomiting
  (h) Other

The material for this study is taken from 52 reports from 68 institutions in 24 states Other material was obtained from institutions which were not using malaria No reports were received from sixteen states Some institutions had abandoned the use of malaria because of difficulty in keeping strains going some because of too many negative inoculations (especially in negroes) some because they consider malaria treatment too dangerous Some referred malaria treatment to sister institutions which were thoroughly organized for carrying out this treatment Others used other thermogenic agents which the Vienna school reserves for malaria refractive cases others have abandoned malaria therapy for diathermy

Some of the data offered in reports appear to be mere approximation Also in some instances statements like Nearly all Not many Very few taken from letters and reprints sent in lieu of categorical answers had to be translated into arbitrary figures to permit tabulation On the whole the data collected are reasonably accurate and complete Upon careful digestion of analyses given in the accompanying letters and reprints I believe that it is safe to offer the figures as giving a fair cross section of the situation

It is proper at this place to express my heartfelt appreciation of the wholehearted cooperation received. Thanks are also due in no small measure to our Superintendent Dr E W Cocke who although mainly interested in diathermy has placed all his patients at my disposal also to our Clinical Director Dr H M Francisco for expert advice and assistance as well as to the whole clinical staff

Table I

DEATH RATES

	No Reporting	Cases	Deaths	Per Ct.	High	Low
Unselected cases	22	3565	338	9 02	24.63	2 2
Selected cases	19	3539	45	1 02	5 86	0
Not stated	11	1265	65	5 14	9 00	0
Totals	52	8354	448	5.38	24 63	2 2

These figures for selected and unselected cases are nearly even but the death rates, 9 02 and 1 02 respectively have a ratio of 9 1

* Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Fifth Annual Meeting New Orleans Louisiana November 18-20 1931
From the Western State Hospital

in the larval gut and consequently on the chance of their being recognized Observations under the micro scope of larvae in the act of feeding revealed no selec tion of food particles. The larvae ingested whatever was presented provided that it was of suitable size The larvae used two methods of feeding upon fila mentous algae At times they inge ted the entire fila ment and at other times they ran a filament between the mandibles chewing and sucking out the cell con tents as it went through the mouth and then discard ing the empty filament Any material subjected to the latter treatment would of course be impossible to identify and there would be no record of its incidence in gut examinations It is believed that the difference in character of available food materials rather than any selection by the larvae accounts in part for the fact that some organisms are recognized in the gut more often than others which are apparently as available and as suitable for food Also in the work here sum marized the determination of organisms present in the breeding water was made from samples of the top half inch of water and there were undoubtedly included certain organisms whose preferred habitat was below that in which Anopheles feeding principally occurs so that they appeared only occasionally in the larval ex aminations

SUMMARY

During the summer months of 1928 and 1929 observa tions were made on various environmental conditions obtaining in Anopheles breeding and nonbreeding waters in northeastern Louisiana to determine if possible those factors which are concerned with the varying degrees of abundance or with the absence of larvae

As measured by the numbers occurring in collections of ten dips of surface water the abundance of larvae in the breeding areas was not greatly affected by variations in the mean summer air temperature which in each month was above 70 F

Protection for larvae is necessary in the water areas studied on account of the presence in abundance of the top water minnow (*Gambusia affinis*) and other natural enemies This is provided in the breeding areas by floating vegetable debris and by various spe cies of plants the best protection being afforded by small floating debris and by filamentous algae Water areas containing filamentous blue green algae in the absence of green algae were not found to be very favor able for Anopheles larvae In areas completely covered by Lemna Anopheles larvae are scarce or lacking but lesser amounts of this material usually indicate breed ing areas. Under certain conditions a rapid decrease in surface water was found to decrease larval inci dence as a result of the stranding of protective mate rials

The plankton content of the breeding and nonbreed ing waters was computed on the basis of the occurrence of the various groups of organisms per c c of surface water It was found that as a rule larger numbers of plankton organisms occurred in the nonbreeding wa ters and this was explained in part by the fact that the breeding waters usually are more shaded and the surface is covered to a greater extent by vegetation and debris, a condition which causes the development of fewer chlorophyll bearing organisms The character of the plankton as regards composition by classes of or ganisms in the different locations varied considerably, but no consistent differences between breeding and non breeding waters were found

The range of the hydrogen ion concentration in the breeding and nonbreeding waters was found to be es sentially the same and all waters were principally alka line in reaction

Examination of the gut contents of larvae showed that any organisms of suitable size are likely to be in gested when present in the water but that some avail able forms are recognized in the gut less frequently than others This may happen because the preferred habitat of certain organisms does not coincide with that in which larval feeding chiefly occurs or on account of the varying degrees of maceration undergone by dif ferent organisms when they are eaten by the larvae

DISCUSSION (*Abstract*)

Dr T H D Griffitts Albany Ga—We have had at different times more or less learned papers on the subject of the breeding of Anopheles in certain vegeta tion A few years ago a paper was published indicat ing or suggesting that malaria had been driven out of the City of New Orleans by means of the water hya cinths which occupied bodies of water in the City To examine bodies of water in one locality and conclude that Anopheles do not breed there because they are not found there may be entirely misleading In many sections water hyacinths furnish the normal home for *Anopheles quadrimaculatus* The same holds true with other classes of vegetation Too frequently we are in clined to classify areas in certain locations as *quadri maculatus* breeding grounds simply because of the fact that they are found there at a particular time In at tempting to find *Anopheles atropos* a certain Anoph eles that produces in salt water to study its ability to transmit malaria I examined a certain salt pool in a marsh (by the way Dr Mohr in your County of Mobile) which had been classed as an *atropos* breeder With high tides it filled with sea water and produced *A atropos* Filled with rain water from continued heavy rains this pool produced *quadrimaculatus*

Mr Bradley (closing)—I have recently been trans ferred to Florida and have found conditions there much like those in Louisiana Some places breed Anopheles continuously others only from time to time Not al ways but often this latter condition is a sociated with environmental changes

reactions to the infection The fever tends down to the tertian type but later after further increase of parasite the paroxysms tend to become quotidian

As to the stage in the cycle of the parasites or the number of chills permitted before using the patient as a donor experiences vary greatly Generally speaking good results have been shown under all conditions of transfer but they have been best when a direct transfer was made Many experiments made abroad for determining the best treatment of blood for shipping show that malaria blood may be infective after seventy two hours if refrigerated As good a plan as any is to defibrinate with glass beads in a sterile vessel and transfer aseptically to the tube in which it is to be shipped. Hemolysis is no bar to results Soon after any method of treatment the parasites escape from the blood corpuscles and assume a spherical gametoid form which however is no disadvantage

In the Western State Hospital (Tennessee) we await several chills determine the ratio of parasites to cells and inject intracutaneously If the ratio is very low we use more blood or inject in two ways The number of c c injected is no measure of the amount of malaria If the first injection is negative we have the experience of greater resistance and proceed accordingly

The answers to the questions as to the number of paroxysms allowed run to a rather high figure averaging perhaps fifteen Individual reports run as high as thirty two or as many as they will have This will be commented upon later

No seasonal influence upon successful inoculations is admitted

No successful method of reducing simple malaria to a tertian periodicity has as yet been developed

With respect to screening it is generally assumed that the strain used is asexual No transmission has been noticed according to reports

Relapses appear to be extremely uncommon This is in striking contrast with the experience of the British using Anopheles malaria

The second part of my questionnaire As to Fatal Cases included questions as to age sex physical risk season of the year none of which was believed to have any bearing except extreme age Two report more deaths in hot weather The authenticity of the strain was generally assumed to be satisfactory The chances are that an accidental introduction of *P falciparum* infection would have declared itself at once by heavy fatalities Some appear to have had no apprehension with respect to the possibility of an intercurrent subtertian infection being satisfied that because the strain was received from a particular source there was no occasion for any concern

The number of paroxysms before death varied greatly Some died after the first second or third chill One rupture of the spleen after five days of apyrexia must have been due to direct violence Another ruptured spleen occurred after the third chill No one will doubt that these were malarial deaths

Under premonitory symptoms of a fatal issue under the questions anticipation duplication or diffusion of paroxysms hyperpyrexia rapid increase of parasites rapid fall of hemoglobin albuminuria bilious vomiting the usual answer was no data The causes mentioned most often were circulatory collapse and convulsions Other causes of death given were hyperpyrexia (three) albuminuria (two) vomiting gastrointestinal disturbance (three) hemorrhage (one)

DISCUSSION

Table 1 shows a wide variation in the fatalities, especially as between selected and unselected groups If the careful selection of cases is an expression of caution the inference follows that these reporters also subject their cases to very careful supervision and management After all malaria is not a drug but an infectious disease and cases should be under the care of someone who understands malaria and should have the benefit of consultation with an expert malariologist There should be repeated checkings of the laboratory work especially of the staining Except in the South and in teaching institutions very few are competent to examine for malaria This important detail seems to be generally neglected

As to selection of cases for the sake of better mortality patients should not be deprived of the benefits of the treatment as surprising results have followed the treatment of desperate cases. Extreme weakness and galloping paralysis are positive contraindications

Regional influence upon death rate percentage of successful inoculations and spontaneous termination may be discussed together The influence upon death rate is complicated by difference in selection of cases in the central group and by the fact that in some large Eastern institutions the work was begun when the effect of paresis upon the course of a tertian malaria was not sufficiently appreciated There is also the factor of large doses and greater number of paroxysms in this group These data balance better in the other three groups

In the South in three institutions there were 192 cases with 2 deaths 27 cases with no deaths and 67 inoculations without a death

As to the other data there is unmistakable evidence of climatic influence and resistance of residents in malarious districts Some Southern institutions report that they have discontinued malaria treatment altogether because of refractoriness in inoculation spontaneous terminations and apyretic course of the malaria Three of our strains have died out in one season In one series of six injections there was not a single take *The Pacific group may claim climate* as there seems to be no other answer

The negro rate has been discussed We expect to experiment with diathermy in refractory cases

The mode of injection and size of the dose doubtless influence the severity of the reactions Massive injections of heavily infected blood into compatible patients may result in dangerous reactions The quotidian char

COMMENT

Some physicians do not accept patients for malaria treatment unless their general condition is good and there are no contraindications. Others accept all cases for treatment but place them under trained supervision which is the policy followed at the Vienna school.* There must be a wide latitude of opinion as to what would be called a good or bad risk. Doubt is expressed by some as to what is properly a malaria death. The most significant fact which emerges from this inquiry is that those who report several series of cases are having better results in their later series. In one report it is stated that "we now have no deaths that *can be strictly ascribed to malaria*." The modes of death and premonitory symptoms will be discussed below. There must be cases in which the cause of death may be indeterminable without an autopsy by a malaria expert.

We inoculated fourteen negroes without a single take. One old negro had a fatal convulsion seven days after inoculation. Parasites had never been found by the thick film method. Such a death after one or two chills might easily be ascribed to malaria.

An attempt was made to ascertain a climatic influence. Institutions were grouped as Eastern, Middle West, Pacific, Southern. In the Middle West group some were in malaria territory.

Table 2

REGIONAL DISTRIBUTION

	No Reporting	Cases	Deaths	Per Ct	High	Low
Eastern group	23	4272	314	7.35	24 63	0
Midwestern group	18	2746	74	2 73	5 88	0
Pacific group	5	994	46	4 62	8 62	2 2
Southern group	5	228	4	1 79	11 00	0

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[illegible] So th n e l d d ncludes ll g neral pares s de the

This table will be analyzed under "Discussion."

In answer to the question "How many successful inoculations?" we get the following data

Table 3

PERCENTAGE OF SUCCESSFUL INOCULATIONS

	No Inst	Cases	Per Ct	Total Inoc.	High	Low	Negroes
Eastern group	17	2675	87 70	3049	100	[illegible]	10-40**
Midwest group	10	1179	96 55	1220	[illegible]	[illegible]	Few
Pacific group	5	994	87 59	1135	97	75	N R
Southern group	4	196	9 03	248	[illegible]	60	F w†
Totals	36	5038	89 13‡	5652			

Comments less one few disco ti ued try i g
†O e ll neg t ve
‡Rep te s do not [illegible] cify n ll cases of gross pe centages in el de neg oes
East n g o p in lud s 10 25 40 60 pe ce t su es.f l in n groes.
Th t tal inoculat ons ar calculated f m the perc tages g e

It is pertinent here to quote Barber Komp and Hayne[1] who collected data on the incidence of benign tertian and total malaria in the Mississippi Delta in all months as follows

Total positive sl des wh tes 2079 benign tert an 51.3 per cent
Total pos t e sl des colored 2446 ben gn te t an 16 5 per cent

This is a ratio of more than three to one. Add to this the fact that the whites live a more sheltered life and are less exposed to infection. Thonnard-Neumann[2] administered 5 to 8 c c of blood containing subtertian parasites to six West Indian negroes who were suffering from disease of the nervous system. In four cases the malaria ran without fever; in two cases it lasted only two to three days; in all but one the parasites tended to disappear spontaneously. When one considers the extreme virulence of subtertian malaria in paretics this is indeed surprising. On the other hand it is reported that negroes are poor treatment risks.

Table 4

SPONTANEOUS TERMINATIONS OF MALARIA

	No Inst	Cases	Spont Term	Per Ct	High Low	Negro
Eastern group	17	3204	374	11 67	0-30	10 50%
Midwestern group	18	1249	128	10 24	0-25	?
Pacific group	4	893	340	?	30 70	?
Southern group	4	173	43	24 85	11 80	Very many
Totals	43	5519	885	15	0-80	

[illegible] t mated from app o m te w

What influence has the method of inoculation and the dose of the injection? Answers to these questions do not lend themselves to tabulation. *A priori* it is assumed that massive intravenous injections into compatible individuals would produce a high percentage of takes and have a short period of incubation. Not a single reporter or writer consulted speaks of the influence of a rich infection. Of course it is known that even when no plasmodia are found the blood may still be infectious. Most writers object to too long a period of incubation. In this age of speed this is an important objection. On the other hand injections of large quantities of blood intravenously giving an actual continuation of the fever in the recipient without a period of incubation throws down the patient rather hard. This of course is not tertian malaria. Hecht Eleda[3] notes as all others have done that in cases of general paralysis injected with benign tertian blood the fever generally runs a quotidian course. On the other hand of syphilitics in various stages other than general paralysis, 285 cases were injected intravenously with 3 to 5 c c of tertian blood. Two hundred and forty seven ran a typical tertian course the highest point being fairly constant between 40 and 41 C (104 105 8 F). The greater frequency of the tertian type of fever in these cases as compared with that in general paralysis is, in the opinion of the author largely due to the difference in the condition of the patient.

The British malariologists[4,5] infecting with mosquitoes call attention to the atypical character of first

*Except in galloping paralysis.

In the fatal group the relation of age sex season physical risk authenticity of strain and number of pa oxysms permitted to death rate was sought

Prompt reco n tion of premonitory symptoms is urged

The pos b lity of an accidental intercurrent estivo autumnal malaria is sugge ted

The des rabil ty of a daily check upon numerical increase of para tes is pre nted

The epidemiological side of malaria inoculation is con idered

The poss ble influence of massive intravenous infec tion and of too prolonged a course of malaria upon death rate is detailed

The importance of perfect hospital organization and a better understanding of malaria as a di.ease is ur ed

Some of the symptoms of fatal cases are discussed

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DISCUSSION (*Abst act*)

Dr W A St atman-Thomas Chattahoochee Fla—One can unde ta d some of the difficulties encountered by Dr Krau s in his evaluation of material from many different sourc s Reliable data cannot be secured un less the case *in question* has b en followed daily by a physic an acquainted w th the clin cal cour e and labo ratory f ndin s of malaria At the Florida State Hospital where malaria the apy has occa.ioned no harm ful effect all patients adm tted to treatment u dergo a rigid exam nat n wh ch ex ludes all but young and robust i d duals The clin cal course and laboratory findings a e followed da l Routine oculation of pa ret cs at th s inst tut on is effected by the utilization of anophe ines harbor n *P v vax* suppl ed through the kindness of Dr Mark F Boyd Director of the Station for M alaria Re.earch Florida State Board of Health Tallahassee In our hands ben gn tertian malaria in duced by application of anophelines has re ponded as read ly to qu nine as a *P v vax* infection obtained by blood inoculation The ex.tence of gametocyte free" *strains is still to be demonstrated* *Unscreened* wards are potential foci of malarial infection and the sugges tion is not untenable that malaria therapy may be partly re pon.ible for sporadic outbreaks of malaria in Northern states It is recommended that the dis charge *of all patients* who have received malaria *therapy* be reported to the proper health authorities as s done in England

Addendum S nce this paper was pre ented I have been able to carry on parallel series of impf and Anoph eles malaria thanks to the courte y of Drs Boyd and Stratman Thoma

A REVIEW OF RECENT ADVANCES IN KNOWLEDGE OF MALARIA*

By CHAS F CRAIG M D M A (Hon) F A C S F A C P †
New Orleans La

In January of the present year Boyd the Secre tary of the National Malaria Comm ttee asked me to prepare a ynops of the contributions to our knowl ed e of malariology that have appea ed during the current year I consented to do so and the present paper i what I regard as a very nadequate synop i for the reason that so many contributions have been made du ing this time to this subject that to cover them all would be imposs ble Accordingly I have r tricted the synopsis to the mo t important of these cont butions and if I have omitted any it has not be n intentional

In urveyin the really va.t amount of literature wh ch has b en published upon mala a during the lat ter port n of 1930 and the present year one m im pressed with the intricacy of the malar a problem and with the fact that the mo e this subject is studied espe c*ally the factors having to do with tran mis on and* infection the greater appears to be our ig orance of many a.pect of this truly protean group of di ea es.

In order that we may survey the additions that have been made to o r knowledge of malaria durin the per od ment ed it will be convenient to divide the ubject a follows

(1) Etiolo y and Epidemiol gy
(2) D agno s
(3) Prophylax s an I T eatment

The bject f the ymptomatolo y of malarial in

R d bef N t l M l C mm tt (C f M laria) meet g co j tly w th So th rn Med cal Association T e ty F fth A l Meeting N w Orl ns Louisi a, Nov m ber 18 0 1931

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†Colo l U S Army u ed

acter of malaria in paretics is evidence of lost resistance. The reticulo endothelial system has been heavily taxed. The Vienna school[6,7] prefers the extravenous route because of the longer period of incubation. It cautions against frantic attempts to overwhelm patients with heavy infection, preferring to reinoculate with another strain or eventually try other pyretogenic methods (such as living sensitized typhoid bacilli). Ebaugh[8], Bahr[9], White[10] and others use this method by preference and also record a very low death rate. This method permits the adjustment of the body to the infection and the tertian type permits a partial unloading of the planchnic circulation. I have a feeling that digitalis is not without danger. I would prefer diffusible stimulants."

Williams[11] states that the effect of injected malaria (in paretics?) on liver function is marked. He prefers the levulose tolerance test to the van den Bergh for the study of function.

It has been stated that malaria too soon after arsenicals fails to take."

Should mosquitoes be used to bring down refractory cases? The propagation and preservation of mosquitoes after infection can succeed only in the hands of specialists with long training. The shipping presents no difficulties, nor need there be any apprehension that they might escape. All this is a matter of technical detail. British writers have thoroughly tested out all the possibilities of the natural method of inoculation. Patients have been refractory to this method also, but where the other method has failed it may nevertheless succeed. The period of incubation is more normal, the periodicity more likely to be typical although even here the quotidian type of fever occurs often. Anopheles malaria is more refractory to quinine, the tendency to recrudescence and relapse is great. The inevitable production of gametes introduces the danger of dissemination, especially in the South, where failures by the blood method are common. Nevertheless it would be very desirable if the United States Public Health Service could maintain one depot so that institutions might start their malaria with one or more authentic strains. Malaria has been successfully transmitted by expressing sporozoites from salivary glands into serum and immediately injecting. Unfortunately these cannot be shipped. At least no attempt has been successful. Southern institutions could confine their transmissions to the winter months and early spring and make a thick film check of the blood in the spring.*

The influence on death rate of keeping up the infection too long must be considered. Those who formerly permitted eighteen to twenty four paroxysms or as many as they will have showed the highest death rate in the period just after the malaria. The extreme emaciation, weakness and blood destruction following prolonged treatment not only defeat the object of the treatment but endanger life. It is better to terminate the infection if the patient does not react well between paroxysms and to inoculate again later.

The discussion of causes of death involves many factors. We have to deal with a seriously damaged patient whose symptoms, especially in the meningovascular type of the disease, may become suddenly aggravated. Any existing cardiovascular damage has to be considered. We should not record a death as due to malaria unless a high degree of infection is noted upon examining a blood smear. In the introduction this has been mentioned. As yet I have not seen a death from malaria in a paretic.

With respect to convulsions many consider a history of convulsions a positive contraindication for malaria treatment. The comment here is in order that this should apply as well to other forms of pyrexia since this is a manifestation of pyrexia rather than of malaria. But convulsions have occurred in the course of malaria in patients who have no history of seizures prior to admission. Bunker and Kirby[13] say:

> * * * * convulsions seem to lie outside of the sphere of coincidences * * * * five of our general paralysis patients (had) * * * * typical seizures, the most recent convulsions having occurred nine days, forty-eight days, fifty nine days, seventeen months and twenty seven months prior to inoculation.

All had some convulsions during the course of the malaria. Three of them died but the other two had no further seizures. On the other hand two without any history developed them during or after the malaria. This excerpt is typical of comments concerning convulsions. All possible premonitory symptoms should be controlled.

The cardiac collapse and the rare cases of ruptured spleen are due primarily to splanchnic congestion. Whiskey is a better drug than digitalis for meeting this indication. Death is often a matter of minutes. The patient should be given an intravenous injection of glucose and caffein sodio benzoate. Mere low blood pressure is a symptom of malaria to be expected during intermission. Gastrointestinal symptoms are danger signals in malaria. The function of the kidneys, and especially the output of urea should be watched. In the absence of facilities for perfect blood work the hemoglobin should be estimated frequently.

SUMMARY

A study of reports from mental institutions using impf malaria has been presented.

The primary object of the study was to determine if possible the reason for high death rates.

A tabulation is presented giving gross rates, rates according to selection of treatment risks, regional distribution, per cent of positive inoculations and conditions influencing them, per cent of spontaneous terminations, season of the year in which failure occurred, number of paroxysms permitted, precautions taken to prevent spread, means employed for reducing the severity and frequency of paroxysms and possibility of relapses.

*I am ot u df l f the f t that winter f ct may ha e ery long period f in batio

are comparatively well known. It is to the species of plasmodia occurring in naturally infected monkeys that the greatest interest attaches.

Koch[11] (1898) was the first to describe a plasmodium in the monkey and since his observations numerous other *investigators have described several species* of plasmodia living not only in the blood of the anthropoid apes but also in common species of monkeys belonging to the genera Cercopithecus, Cercocebus, *Cynocephalus and others. A considerable amount of* literature has accumulated concerning the species of malaria plasmodia occurring in monkeys and while some of these parasites are indistinguishable morphologically and in their life cycle from the plasmodia found in man none of them has been demonstrated to be identical with the human parasite by experimental evidence.

In 1930 Clark[1] described two species of plasmodia occurring in monkeys in Panama, one resembling in morphology *Plasmodium vivax* and occurring in the monkey *Ateles geoffroyi*, while the other resembled *Plasmodium malariae* in morphology and occurred in the monkey *Cebus capucinus imitator*. Clark found that young monkeys infected with these plasmodia frequently died as a result of the infection while those that survived became moderately good carriers. He noted that no plasmodium was found in monkeys in Panama resembling *Plasmodium falciparum* in morphology.

With the exception of the species described by Clark there is record of but one other species of plasmodium in monkeys in the *Western Hemisphere, the so called Plasmodium brasilianum* found in a monkey of the genus *Brachyurus* in the Amazon district by Gonder and Gossler[13] in 1908.

In a later paper Clark[14] (1931) details the results of certain experiments upon human volunteers in an endeavor to transmit the plasmodia found in monkeys in Panama to man. The volunteers were soldiers of the United States Army stationed in Panama and five men were given direct inoculation of monkey blood containing plasmodia both intravenously and subcutaneously, two men subcutaneous inoculations of heavily parasitized monkey blood and three men were bitten by infected anopheline mosquitoes, the mosquitoes used being *Anopheles tarsimaculatus*, *Anopheles pseudopunctipennis* and *Anopheles albimanus*. All of these experiments resulted negatively and Clark concludes that the malaria plasmodia of Panama monkeys are not identical with the species occurring in man which they resemble morphologically.

As I have pointed out elsewhere (1931)[15] the number of experiments that have been made upon man in attempting to transmit plasmodia of monkeys have been so few that even though resulting negatively they cannot be considered as proving beyond doubt the impossibility of transmission. While it is very suggestive that even among monkeys experiments have apparently demonstrated that *it is impossible to transmit the* malaria plasmodia of the anthropoid apes to lower monkeys and vice versa and that it is most probable that the plasmodia occurring in various other mammals are so specific that their transmission from one species of animal to another is impossible it should be remembered that in the process of evolution the malaria plasmodia of man developed from those of some lower animal in all probability so that experiments upon much larger numbers of human volunteers might result in success. The subject demands further study using *a much larger number of volunteers for the purpose* before we can state that the transmission of the malaria plasmodia in monkeys to man is impossible. The most that can be said at present is that the relation of the plasmodia occurring in the blood of monkeys and anthropoid apes to those occurring in man is still an unsolved problem. Some authorities, as Reichenow[16] (1920) believe that the plasmodia occurring in the chimpanzee are identical with those occurring in man and that these animals act as reservoirs and carriers of malarial infection but it must be admitted as noted later that all attempts to transmit the plasmodia of man to monkeys with one doubtful exception have resulted in failure. While the plasmodia occurring in the blood of anthropoid apes and some of the lower monkeys, are morphologically indistinguishable from those occurring in man there is as yet no evidence of real scientific value that they are identical or that man can be infected from monkeys.

Transmission of Malaria Plasmodia to Lower Animals.—In the past many attempts have been made by numerous investigators to transmit the malaria plasmodia of man to lower animals. It is impossible at this time to review all of these attempts and it is sufficient to state that there is but one record of apparent success, and this a doubtful one. In 1920 Mesnil and Roubaud[17] claimed to have produced an infection in a young chimpanzee by the intravenous inoculation of blood from a case of infection with *Plasmodium vivax* but they stated that they failed in a second attempt with another chimpanzee and were unable to infect till another by the bites of infected anopheline mosquitoes. The success of this experiment is rightly questioned by many authorities, as it was impossible to be sure that the chimpanzee may not have had a natural *infection with the plasmodium that occurs in these* animals and that is indistinguishable in morphology from *Plasmodium vivax*. Such a latent infection may have been stimulated by the injection into the chimpanzee of a foreign protein such as human blood, for Knowles[18] in 1919 reported an instance in which a monkey was inoculated with human blood containing only gametocytes of *Plasmodium falciparum* but which became ill twenty four hours later and died within forty eight hours with a very intense malarial infection with plasmodia resembling both *Plasmodium falciparum* and *Plasmodium vivax* in the blood. As it is obviously impossible for this fatal infection to have originated from the injection of the blood forty-eight hours before *the blood containing gametocytes only it is evi*dent that the reaction produced by the injection of

fections has not been included as no contributions of great importance upon this phase of malaria have been published during the year

(I) ETIOLOGY AND EPIDEMIOLOGY

(A) *Classification* —Little has been added to our knowledge of the various species of malaria plasmodia insofar as classification is concerned There have been no departures from the general acceptance of three distinct species *Plasmodium vivax Plasmodium malariae* and *Plasmodium falciparum* Further extensive work upon the treatment of paresis with malarial infection has only strengthened the evidence of the validity of these three species and there has been no instance recorded in the literature relating to the experimental production of malaria in paretics in which one of these species has been transformed into another either morphologically or clinically It has been found that these species invariably breed true

The question of the existence of still other species of human malaria plasmodia is a moot one The existence of the quotidian sub species of *Plasmodium falciparum* to which in 1909 I[1] gave the name *Plasmodium falciparum quotidianum* and which was first well differentiated by Marchiafava and Bignami[2] (1892) is still a matter of controversy but the trend of modern opinion appears to favor the view that such a species or sub species is found in certain regions where the estivo autumnal fevers are most pernicious in type Thus James and Kauntze[3] (1930) as the result of their researches on malaria in Kenya Colony East Africa recommend a more careful study of the estivo autumnal plasmodium found in Kenya as they think that it is uncertain that in morphology it is identical with *Plasmodium falciparum* It will be remembered that Ziemann[4] (1916) described the plasmodium occurring in this region as a new species under the name *Plasmodium perniciosum* but it also agrees closely in its morphology with *Plasmodium falciparum quotidianum*

As regards the validity of *Plasmodium vivax var minutum* which in 1900 I[5] described as a variety of *Plasmodium vivax* and which Ahmed Emin[6] named and redescribed in 1914 the paper by Yorke and Owen[7] published in 1930 is of interest These investigators report finding this species in the blood of a patient in Nigeria and they were able to reproduce the infection in paretics the plasmodia in their blood having the typical morphology and tertian periodicity described for this plasmodium

The specific status of *Plasmodium tenue* described as a new species by Stephens[8] in 1922 is still undecided and there have been no new data published during the past year regarding this organism

While the question of the specific status of all of these plasmodia is yet undecided in view of the comparatively recent discovery by Hartman[9] (1927) that a supposedly single species of avian plasmodium *Plasmodium praecox* well known to and studied by protozoologists for many years really included no less than three distinct species it is certainly the part of wisdom to investigate very carefully the claims of the validity of these new species before denying their existence I believe that we have still much to learn regarding the morphology of the various plasmodia produring malaria in man and that the possibility of the existence of species distinct from the three generally accepted plasmodia of man demands much more open minded and extended research than has as yet been given it.

(B) *Distribution of Malaria Plasmodia* —A number of papers have appeared during the year upon the distribution of the various species of malaria plasmodia While these papers are of interest and importance to local practitioners and health officers, the only contribution of great general interest that has appeared is a Memoir issued as one of the Indian Medical Research Memoirs by Knowles Senior White and Das Gupta[10] (1930) This Memoir is a most comprehensive study of the parasitology of malaria throughout the world with special reference to the distribution of the species of plasmodia The distribution of these parasites in all parts of the world is exhaustively considered and the conclusions drawn especially as regards the probable evolution of the plasmodia, are of much interest The authors conclude that *Plasmodium malariae* is the oldest in the scale of evolution and that it is actually a disappearing species The special association of this plasmodium with primitive tribes and its spotty distribution throughout the world suggest that its present endemic areas are the remains of much more extensive and widely distributed foci while *Plasmodium vivax* and *Plasmodium falciparum* are more recently evolved species They are inclined to think that the severity of the symptoms produced by the latter parasite are largely due to its having been associated with man for a much shorter period of time than the other two species

They call attention to the fact that most of the species of plasmodia living in the blood of lower animals especially monkeys resemble *Plasmodium malariae* in their morphology and for this reason believe that this parasite must have existed prior to the evolution of man and presumably in the lower Primates as its vertebrae host This portion of the Memoir is most interesting and suggestive and should be read by all interested in the evolution of human parasites The entire report is a masterly presentation of the subject of the distribution of malaria plasmodia throughout the world and it also contains many valuable data regarding the epidemiology of malaria in general

(C) *Malaria Plasmodia in Lower Animals* —The occurrence of the malarial fevers in so called uninhabited regions as reported by numerous observers has led some authorities to believe that some natural *reservoir of* infection must exist in one or more of the lower animals The fact that plasmodia similar in morphology to the plasmodia occurring in man have been found in lower animals especially in monkeys has rendered the study of this question of general interest to malariologists

Several different species of plasmodia have been found in the mammals and the species occurring in birds

tion to some of these factors and during the past year several contributions have appeared which add to our knowledge of the subject

(a) *Factors Concerning the Development of the Plasmod a in Man*—It is evident that in order for ma laria to be tra smitted from man to man individuals mu t be present who have gametocytes in their blood the so called carriers of the infection The e carriers mu t be numerous enough to infect a con iderable num ber of mosquitoes Otherwi e infection will die out in a locality The percentage of individuals who pre ent gametocyte in the blood varies with the different spe cies of plasmodia and under different biological con ditions In some localities and under ome conditions as high as 70 to 80 per cent of ind viduals sufferin from mala ia pre ent gametocytes in their blood while in other localit e as low as 10 to 12 per ent only have hown gametocytes in the blood

In the paper mentioned previou ly Garnham (1931) con iders everal of the problems having to do with the sexual forms of *Plasmod um falc pa um* and his re sults are intere ting and valuable As regards the pro portion of individuals show ng gametocytes of *Plasmo dium falciparum* he found that of 183 cases of infec tion w th this parasite 159 or 87 per cent showed crescents in the blood Garnham s observations were made in Kenya Colony Africa and his re ults as re gards the high percentage of indiv duals showing cres cents while unusual have been equalled in other trop cal countries as reported by other ob ervers

The time of occu rence of the gametocytes in the peripheral blood was invest gated and he found that the average period between the onset of symptoms and the app rance of crescents was 11 days In one in stance crescents appeared in 3 days and in one case 5 days after the onset of ymptoms He tates that the number of crescents varied at diffe ent t mes and that they apparently occurred in waves commenc g at or about the ele enth day after the appea ance of symptoms and continu ng as a wave for an a erage of 14 days He bel eves that this explains the re ults of Clark [8] (1927) and Green [9] (1929) who descr bed an ncrease in the number of crescents after treatment w th quin ne Green in 50 fections w th *Plasmod um falc parum* found 50 4 per cent cases showing crescents before treatment with qu nine and 64 per cent after 7 d ys treatment with quinine Garnham tates that thi increase corre ponds to the normal curve of the number of gametocytes as t occu s n untreated cases. Garnham found that the length of time the crescents rema n n the circulation d pends upon the number of relapses If relapses are very numerou the cre cents may be continuously present in his experience for as l ng as 128 days but usually for not more than 14 days He states that in the early stage of nfection qui nine inh b ts c escent format on As regards the point of origin of the crescents Garnham made splen c punc tures in 48 ca es and found c escents in the splenic pulp in 32 case never before the sixth day of the disease and 2 d ys *before their appearance in the per pheral* blood He discusses in a very nteresting manner the theories of the mechanism of gametocyte production tating that there are two principal theories that of Sinton[30] (19 6) who believes that they are due to a change in the pH of the spleen and the theory that gametocyte p oduct on is a sequel of immunity C rn ham concludes that there is no proof that S nton s the ory s correct and against the theory that cre cents are produced as a sequel of immunity is the fact that in 10 new infections be inoculated erum from heavy crescent carriers and these inoculations were not followed by the appearance of crescents in the blood of the patients He also states that crescents do not appear in recru de cent ca es although immun ty mu t be present while in malignant cases of malaria crescents occur although immun ty is ab ent He bel eves that there are present in the blood of malar al patients two antibodies one de troying the asexual para ites and the other influenc in gametocyte production The fir t causes sponta neous ecovery from the infe tion either through lysis or phagocyto is The second antibody is produced by the reaction of the human body to the primary lot of cre cent but this ant body does not perm t for long o that in relapses (cases occurring after 30 days) cres cents appear while in recrude cences (ca es occurring within 30 days) they do not

Another nterestin and suggesti e paper is that of Green[31] (1929) who found that there was no true correlation between the number of gametocytes in the malarial pat ent s blood and his power to infect mos quitoes In everal cases patients with relatively few gametocytes were infecti e whi e others having many more gametocytes n the blood were un nfective In an endeavor to find an explanation for this phenomenon Green investigated the influences of the temperature of the pat ent the p esence of *trophozoites variations in* the hemoglobin index in the number of leucocytes and the presence or absence of e largement of the spleen but none of these factors appeared to influence infec tivity for the mosquito although it was noted that en lar ement of the spleen was more common among ca es failing to infect He found that the m nimum number of gametocytes necessary to infect *Anopheles macul tus* was in the ca e of *P falc p rum* 1 200 leucocytes, or 42 per 1 cu mm of blood in he case of *P v vax* 1 1000 leucocyte or 10 per 1 cu mm of bl od and with *P malariae* 1 330 leucocytes = 27 per 1 cu mm of blood. Green s re lts in this re pect vary f om those of many others, but it must be tated that authorities are not ag eed as regards the mini mum number of gametocytes wh ch are necessary to infect mo qu toes nor is it probable that any agree ment will ever be reached upon this question for un doubtedly the number will vary with different pecies of mo qu toes and under diffe ent biological condi tions It would appear that research along this line is large y wasted so far as any pract cal results can be hoped for

The relat on of the sex of the gametocytes to power to infect mosquitoes is still under discussion and in the paper referred to Green tates that there appeared to be no correlation between the number of male and

the foreign protein lighted up a pre existent latent in fection with the monkey plasmodia

The most recent attempt to transmit the malaria plasmodia of monkeys to man is that of Marginesu[19] (1930) who attempted to transmit *Plasmodium vivax* to young rabbits and monkeys (*Macaccus rhesus*) by in oculation of blood rich in schizonts and gametocytes of this species An examination of the blood at inter vals of from two to twenty days after inoculation re sulted negatively and the inoculation of the blood of these animals into patients suffering from mental disor ders did not produce malaria

Species of Mosquitoes Transmitting Monkey Mala ria—Until recently we possessed no knowledge of the species of mosquitoes acting as transmitting agents of the plasmodia of monkeys from monkey to monkey Clark [0] in 1931 was successful in infecting two speci mens of *Anopheles tarsimaculatus* and one of *Anopheles albimanus* fed on monkeys with plasmodia in their blood and found sporozoites in their salivary glands This is apparently the first successful experiment in which mosquitoes have been infected with the malaria plasmodia of monkeys and has been confirmed by Green[21] (1931) who in a contribution presented be fore the Royal Society of Tropical Medicine and Hy giene stated that he was able to infect laboratory bred *Anopheles maculatus* and *Anopheles kochi* with a plas modium found by MacSwan in the monkey *Macaccus cynomolgus* in the Malay Peninsula Not only was Green able to infect these mosquitoes but he traced the development of the plasmodia until the sporozoites appeared in the salivary glands His experiments with *Culex quinquefasciatus* and *Aedes albopictus* in an en deavor to infect them with the same parasite resulted negatively He noted that the morphology of the de velopmental forms of the parasite in this mosquito were indistinguishable from those of *Plasmodium vivax* in the same insect and the rate of development was the same He called attention to the wide distribution of this common monkey in Malay and other countries and urges caution in attaching too much importance to finding developmental forms of the malaria plasmodia in mosquitoes so far as indicating the amount of hu man malaria in regions where this species of monkey occurs

Morphology of Malaria Plasmodia—During the past year no contributions have been made which add to our knowledge of the morphology of the various species of malaria plasmodia The question of parthenogenesis of the macrogametocyte still agitates some malariolo gists despite the very definite proof that has accumu lated that this process does not occur Garnham (1931) in an excellent paper dealing with the gameto cytes of *Plasmodium falciparum* states that there is some evidence morphologically of the ocurrence of parthenogenesis but he does not give this evidence He believes that there is nothing against the occurrence of this process in the malaria plasmodia from the bio logical standpoint but considers that there is not suf ficient proof that it does occur It would appear that the numerous experiments demonstrating that the in jection of blood into man containing only gametocytes is not followed by infection and the occurrence of symptoms of malaria should be sufficient to decide this interesting point

Cultivation of Malaria Plasmodia—It will be recalled that Bass and Johns [5] (1912) first perfected the tech nic and were able to cultivate all of the three species of malaria plasmodia of man all stages in the human life cycle being observed in the cultures Their observa tions were soon confirmed by others and some modifi cation have been made of the original technic the best known being those of Thomson and Thomson[24] (1913) and Sinton [5] (1922) During the past year a paper has appeared by Dominici and Rocca [6] (1930) de scribing a modification of the technic of cultivation of malaria plasmodia which they have found useful This modification is as follows blood is taken from a patient by venipuncture and 4 to 5 drops are placed in small glass tubes containing 1 c c of human blood serum inactivated by heating to 56 C for half an hour and 2 drops of 50 per cent dextrose These tubes are then placed within larger tubes for anerobic culti vation at 37 and 24 to 26 C. When a portion is withdrawn for examination after 48 hours there are added a few drops of fresh defibrinated human blood

In this medium the author states that the parasites (apparently *P vivax*) have sporulated after 48 hours and they found that the results were equally good at 37 C and at 24 to 26 C Whether this modified technic is superior to the original technic remains to be seen as there has been no confirmation of this work

Transmission of the Malaria Plasmodia—Up to the present time the only method of transmission of malaria from man to man which has been experimentally proven is through the bites of mosquitoes belonging to the genus Anopheles In order for this to occur the malaria plasmodia have to undergo a cycle of develop ment in these insects and while some authorities have suggested that the infection may be transmitted me chanically by mosquitoes there is at present no proof that this can occur The mechanical transmission by mosquitoes has been advanced to explain sudden and extensive epidemics of malaria that have been observed from time to time and while it is somewhat difficult to explain these epidemics by the transmission of the infection in the usual manner there is no scientific evidence available proving that malaria can be trans mitted mechanically by mosquitoes

While the evidence is complete that malaria is trans mitted by Anopheles mosquitoes there are many factors concerned which are just beginning to be understood and which demonstrate how complex a process this method of transmission may be in Nature Many pa pers have been published within the last few years by competent observers tending to show how little we really know regarding the biological processes that gov ern the transmission of this disease from the standpoint of the infected individual the mosquito transmitting the infection and the recipient of the infection In a previous communication (1928) I [7] have called atten

capable of tran mitting the malarial fevers in different countries of the world Owing to the interest which attaches to th s important question a list of these mosquitoes as given by Covell follows

LIST OF THE CHIEF MALARIA CARRYING ANOPHELES OF THE WORLD

I AMERICA

North America

United States
A quadr maculatus (south and ea t)
A macul pennis (Pacif c coast)

Mex co
A alb manus (coa t)
A pseudopunctipennis (h ghlands)
A quadr maculatus (highlands)

Central Amer ca and West Indies
A albim nus
A t s maculatus

South Ame ca

Guiana
A albima us
A albitarsis

Venezuela
A alb manus
A albitarsis

Colomb a
A albimanus

Ecuador
A alb manus

Braz l
A albita sis
A tarsimaculatus

Argent na
A pseudopunct pennis (northwest)
A lb tarsis (northeast)

II EUROPE

All Count es where M laria Occurs
A macul pennis

Balkans
A superpictus

Italy and Macedonia
A sacharovi (elutus)

III AFRICA

No th Africa

Algeria
A ma ulipennis
A alge ensis

Trip li
A alg ien is

T op cal Af ica

Through Tropical Afr ca
A gamb ae (costal s)
A f nest s

Bel an Co
A marshallii var mouchet nill

IV ASIA

As a Minor Transcauca a and Central Asia
A maculipe n s
A sacharovi (elutus)
A sup rp ctus

Palestine
A sacharovi (elutu)
A sergentii
A superpictus

Arabia (south)
A gambiae
A culicifacies

Mesopotamia
A superpictus (north)
A stephensi (outh)

India and Ceylon
A cul c facies
A stephensi
A liston
A m nimus (*funestus*)
A maculatus
A ludlo ri
A philipp ensis

Siam
A ludlow i
A maculatus

Malaya
A maculatus
A umb osus
A ludlowii

Cochin China
A maculatus
A leuco phyrus

China
A hyrcanus var s nensis
A maculatus
A min mus (*funestus*)

Formosa
A maculatus
A m nimus (*fi nestus*)
A hy ca us var s nens s

Japan
A hy canus va sinensis

V EAST INDIAN ARCHIPELAGO

Dutch Ea t Ind es
A ludlo i
A m culatus
A aco itus
A umbrosus
A hyrcanus (s ne s s)
A leucosphyrus
A koch (occasionally impo tant)
A p nctulatus (ea tern lands)

Borneo and Labuan
A li dlo ii
A i mbros s
A leucosphyrus

Philipp e Islands
A m nimus (*funestus*)
A l dlo ii

VI AUSTRALASIA MELANESIA AND POLYNESIA

New Guinea
A pun tulatus

New B itain
A pu ctulatus
A pi nctulatus va mol cce sis

New Heb des
A punct l tus

North Q eensland
A p ctulat s

female gametocytes as regards infectivity of the mosquito He concludes that the evidence for or against the reduction in infectivity due to abnormally disproportionate male and female gametocytes is inconclusive in the case of *Plasmodium falciparum* and *Plasmodium malariae* but in the case of infection with *Plasmodium vivax* there appeared to be some evidence that when females are greatly in excess of the males the infectivity of the mosquito was reduced

The influence of quinine upon gametocytes in the blood of a person harboring this stage of development of the plasmodia is still receiving attention and there appears to be a considerable difference of opinion regarding this question It will be remembered that Wenyon[32] (1921) demonstrated that mosquitoes could be infected with *Plasmodium falciparum* from patients taking quinine but that infection rarely followed in the case of *Plasmodium vivax* and he concluded that quinine affected the gametocytes of *Plasmodium vivax* but not those of *Plasmodium falciparum* His results were confirmed by Mayne[33] (1922) and Barducci[34] (1926) but the latter observer found that patients taking large doses of quinine and infected with *Plasmodium falciparum* were not infective to *Anopheles maculipennis*

These observations which have been generally accepted as proving that quinine in sufficient dosage rendered the gametocytes of *Plasmodium falciparum* non infective to mosquitoes, are contradicted by the recent investigations of Green[35] (1929) who in a carefully conducted series of experiments obtained the following results Infections of the mosquito with *Plasmodium falciparum* were obtained from patients after a maximum of 16 days quinine treatment of the patient harboring the gametocytes these patients having been given 10 grains of quinine two hours prior to feeding the mosquitoes As regards infections with *Plasmodium vivax* and *Plasmodium malariae* mosquitoes became infected from cases receiving quinine treatment after a maximum of 13 days It will be noted that these experiments confirm those of Wenyon but do not confirm those of Barducci as regards the effect of quinine upon *Plasmodium falciparum* gametocytes

Green states that the viability of the gametes of *P falciparum* is not affected by past or recent quinine treatment and he found that quinine treatment of the human host did not affect the development of the gametocytes in the mosquito

In a valuable paper published in 1931 James[36] states that the number of gametocytes is not as important so far as the infection of mosquitoes is concerned as their quality He obtained negative results with *Anopheles maculipennis* fed on patients with gametocyte counts as high as 12 to 100 leucocytes (900 per cu mm) and even higher and positive results in cases having as low as 1 to 200 leucocytes (42 per cu mm) in their blood He judges the infectivity of a patient by the number of exflagellating gametocytes with reference to the number of leucocytes the blood preparations being thin smears kept in a moist chamber at 25 C He found that *Anopheles maculipennis* did not become infected if the number of exflagellating males in a moist chamber preparation kept at 25 C fell below 1 to 1000 leucocytes In other words his experiments indicate that some of the gametocytes are sterile and that the mere number present in the peripheral blood is not an index of the infectivity of the patient to the mosquito

(b) *Factors Concerning the Development of the Plasmodia in Mosquitoes*—As stated the malaria plasmodia of man can be transmitted from man to man *only by mosquitoes belonging to the Anophelinae so far* as known at present The question of the possible development of these plasmodia in other genera or species of mosquitoes has attracted some attention recently and in a discussion before the Royal Society of Tropical Medicine and Hygiene in 1930 Wenyon[37] stated that a Russian worker whom he did not name had *shown that the stages of development of Plasmodium vivax* up to the formation of the ookinete had been observed in species of Culex Aedes and Taeniorynchus as in Anopheles but that further development did not occur However it must be admitted that comparatively little work has been done upon the subject of the possibility of the transmission of malaria by mosquitoes other than Anopheles and in view of the recent work upon yellow fever and dengue it would appear that further research in this direction is indicated

But little has been added to our knowledge of temperature conditions and humidity so far as they influence the development of the malaria plasmodia in the mosquito The observations of King[38] (1917) Wenyon [9] (1921) and others that the plasmodia are able to resist temperatures between 0 and 8 C have been confirmed and it is undoubtedly true that under certain conditions mosquitoes can transmit malaria after hibernating through a winter season

In an interesting paper discussing the amount of blood ingested by various species of mosquitoes and the relation of this to the infectivity of the mosquito James[40] (1931) states that he could find no correlation *between the number of zygotes developing in the insect* and the amount of blood ingested He also found that not all mosquitoes having sporozoites in the salivary glands were infective to man as some of his patients did not become infected even though bitten by mosquitoes with sporozoites in the glands He explains this condition by stating that the sporozoites must be not only in the cells of the glands but lying free in the common salivary duct He apparently did not consider the possibility of immunity in the patients who did not develop malaria

The different species of Anopheline mosquitoes that *act as principal transmitters of malaria in different* parts of the world have been thoroughly considered by Covell[41] (1931) In a very valuable compilation of the available data concerning this question this author has detailed under appropriate headings the mosquitoes that have been found both naturally and experimentally

recipient of the sporozoites from the mosquito will prevent the development of the plasmodium in the blood of that individual and this probably explains the difficulty or impossibility of producing the disease in some individuals. It is a well known fact that in any region where malaria is intense the native population after reaching early adult life is practically immune to the disease and in such regions the newcomer is the chief infector of mosquitoes as the examination of the blood of a large proportion of the natives results negatively so far as the presence of plasmodia are concerned. The importance of this condition as regards prophylaxis will be noted later.

The part that phagocytosis plays in destroying the sporozoites inoculated by mosquitoes or the schizonts developing from the sporozoites is probably very important in the prevention of infection. In a recent paper dealing with acquired immunity in avian malaria Cannon and Taliaferro[5] (1931) state that acquired immunity to infection and superinfection is associated with phagocytosis of the parasites by macrophages and that the mechanism of immunity to superinfection is primarily cellular consisting in an increased rate of phagocytosis by the cells of the reticulo-endothelial system especially those of the spleen and liver. These observations of Cannon and Taliaferro are confirmatory of what has long been known concerning phagocytosis in human malaria. Every student of malaria who has had a large experience has stressed the importance of the destruction of the malarial parasites by the macrophages and has called attention to the importance of phagocytosis in the prevention of symptoms and the spontaneous cure of malarial infections.

However the demonstration of immune bodies in the blood by the investigators mentioned indicates that immunity depends not only upon phagocytosis, but upon the presence of immune substances in the blood stream.

II. DIAGNOSIS OF MALARIAL INFECTIONS

Little progress has been made during the past year in devising methods for the diagnosis of malarial infection other than by the demonstration of the plasmodia in the blood of the infected individual and this method still remains our only reliable and practical method of making a scientific diagnosis. The thick film method is still under discussion although there seems to be no good reason why it should be. The consensus of opinion at the present time is that this method is of the very greatest value in the hands of experienced individuals especially in making malaria surveys and in patients in whom the parasites are so few in number as to make it difficult to demonstrate them in the peripheral blood. Personally I believe that if enough time is spent upon properly prepared blood smears of the peripheral blood the parasites can be demonstrated in any individual presenting symptoms of infection and that the thick film method is not necessary for ordinary clinical diagnosis of patients showing symptoms. In latent infections and in individuals who are presumably cured the thick film method is of great service as by it parasites may often be found when the examinations of several blood smears from the peripheral blood are negative.

A most valuable paper appeared during 1931 by Knowles[6] upon the laboratory diagnosis of malaria. It is a contribution that should be read by every malariologist interested in the examination of the blood for malaria plasmodia and it will well repay careful study. He considers the various methods of making blood films, the use of the thick blood film, the various stains that are most useful in diagnosis, the difficulties that are encountered in staining and the personal factor concerned in the examination of blood films. One of the most interesting statements made by the author is that in the Protozoological Department of the Calcutta School of Tropical Medicine the Bass culture method has been used as a routine method of diagnosis in every case with most excellent results since 1929. The author claims that it will enable one to diagnose cases in which the parasites are so scanty that they cannot be detected in either thick or thin blood films and that where only ring forms are encountered and the diagnosis of the species is uncertain cultures will enable one to diagnose the species with certainty. He has also found it of special value in individuals who have taken small doses of quinine which were sufficient to prevent finding parasites even in the thick film but insufficient to control the fever. He details the technic which they employ which is a slight modification of the original Bass-Johns technic and he concludes this portion of the paper by stating that the cultivation method is of great service in demonstrating whether all parasites have been destroyed by various methods of treatment.

Another interesting and valuable fact brought out in the paper is the great influence of the personal factor in the results of blood examinations. The author details four tests. In the first eight microscopes are set out and under each a single malaria parasite was focused in the field. Forty five medical students were then allowed three minutes each to examine the specimen and to present a report. The results showed an accuracy of only 41 per cent. In the second test seven microscopes were set out and under each a malarial blood film. The same forty five students were allowed five minutes at each microscope and allowed also to use the mechanical stage and cover as much of the film as possible. The percentage of accuracy under these conditions rose to 80. Tests one and two were repeated with experts who had been diagnosing malaria species during practically a life time of laboratory work in the tropics. Test three consisted in a repetition of test one with these volunteers and the percentage of agreement was 63. Test four consisted of a repetition of test two in which five minutes were allowed for the examination and all portions of the specimen could be examined. In this test with experts the percentage of agreement with regard to the species present rose to [illegible]. From these observations it is evident that even experts do not always agree in the diagnosis of the various species of malaria plas-

Limit of Flight.—The observations as to the limit of flight of anopheline mosquitoes of Bascom[4] (1920), Wenyon[43] (1921) and others have been confirmed by several observers. It will be remembered that Bascom in 1917 stated that anopheline mosquitoes frequently fly from 2 to 2½ miles in search of a blood meal and Wenyon that the range of flight is often 2 or 3 miles or even more. As long ago as 1906 [illegible] I noted that at Camp Stotsenberg in the Philippines anopheline mosquitoes flew over two miles in order to secure a feeding of blood. This statement was received at that time with incredulity by entomologists who considered that these mosquitoes had a very limited flight, but in 1910 Darling[44] confirmed my observations, followed by the investigators already mentioned. Further study of this subject has only confirmed these observations and has proven that under certain conditions mosquitoes transmitting malaria fly for long distances. Reitler and Salsternik[45] (1929) demonstrated that in Palestine the flight of anopheline mosquitoes varied from two to six miles, while Manalang[40] has found that the flight range of *A. funestus* (*minimus*), the principal transmitter of malaria in the Philippines, is over one mile.

(c) *Factors Concerning the Recipient of the Plasmodium.*—It is a well known fact that some persons are resistant or immune to malaria and experimentally it has been shown that it is impossible to infect some individuals either by direct inoculation of blood containing the malaria plasmodia or by the bites of infected mosquitoes. It is a common experience with those who have to do with large bodies of men in malarial localities that certain individuals never develop the disease although they live under the same local conditions as regards infection as those who do develop the disease. This immunity may have been acquired by repeated infections during early life, but it may also be a real natural immunity, for numerous investigators have described instances of individuals living in the most malarial localities who never suffered even in infancy from the infection. Recently James[47] (1931) has described the results he obtained in the experimental production of malaria by the bite of infected mosquitoes in paretics. He records 1,356 individuals bitten by *A. maculipennis* having sporozoites of *Plasmodium vivax* in the salivary glands, of whom 985, or 72.5 per cent, developed tertian malaria, while 371, or 27.5 per cent, failed to do so. Many of these individuals could not be infected although repeatedly bitten by infected mosquitoes. A valuable paper dealing with immunity in experimental malaria is that of Ciuca, Ballif and Vieru[48] (1930), which appeared in the latter part of 1930. They note that a high infant mortality is present in intensely malarious regions in Roumania and that after the third year of life an immunity is acquired. They made observations on a group of 518 patients who were receiving inoculation of malarial blood for paresis and other diseases, and they found that the percentage of positive results following a single inoculation of blood containing *Plasmodium vivax* was 53.3, of blood containing *Plasmodium malariae* 61.3, and of blood containing *Plasmodium falciparum* 80 per cent. Of these successful inoculations 18.6 per cent of the tertian cases, 15 per cent of the quartan cases and 18 per cent of the estivo-autumnal cases showed parasites in their blood without fever or other symptoms and most of them recovered spontaneously from the infection, the parasites disappearing from the blood. After repeated inoculations of blood containing *Plasmodium vivax* an immunity was obtained in 100 per cent of those inoculated, even when as large a quantity of blood as 65 to 220 c. c. was used for the inoculations. However, they found that only 67 per cent of these individuals resisted inoculations with another strain of *Plasmodium vivax*. They also determined that there is no cross immunity between the three species of malaria plasmodia. These observations confirm those of James, Nicol and Shute,[49] who in 1927 showed that in treating paretic patients by producing malaria by the bite of infected mosquitoes repeated inoculations by the mosquito produced an immunity to the particular strain of the plasmodium with which the mosquitoes were infected. Using a certain strain of *Plasmodium vivax* the attack produced by the first inoculation by the mosquito was normal in severity and symptomatology and had to be terminated by treatment; the attack produced by the second inoculation by the insect usually died out spontaneously, while after the third inoculation by the mosquito infection failed to result or the infection was unaccompanied by symptoms and only a few plasmodia were present in the peripheral blood. However, this immunity was only for the particular strain of *Plasmodium vivax* employed in the experiments, as another strain of the same species, when inoculated by the mosquito, produced infection and the development of symptoms. They found that though the new strain was able to produce infection, the attacks produced died out spontaneously, so that a slight immunity even to the new strain must have been present.

Until within recent years, although we possessed a large amount of clinical evidence demonstrating that immunity to malaria could be produced by repeated infections, no definite evidence had been produced showing the presence of immune substances in the blood of individuals having malaria or recovering from the disease. Thomson[50] in 1919, Horowitz and Wlassowa[1] in 1924 and Kingsbury[5] in 1927 demonstrated that complement binding substances existed in the blood of patients suffering from malaria, while Taliaferro and Fisher[53] in 1927 and Taliaferro and Taliaferro[54] in 1928 have shown that precipitins also occur in the blood of malarial patients. During the past year no new work has appeared upon the subject, but it is believed that no doubt exists as to the presence of immune substances in the blood of patients who have suffered from infection with the various species of malaria plasmodia.

It is obvious that the presence of immunity in a

antimosquito measures and the writer details the results obtained in a town in Sardinia of 6000 inhabitants which was noted as a malaria center. When the work was begun about one half the people had chronic malaria but after four years of application of antilarval measures the parasite index of the population was reduced from thirty four to three, the spleen index from forty seven to thirteen, and the reported cases from thirteen hundred to two hundred. The method adopted was dusting with Paris green and the annual cost for four years averaged about twelve hundred dollars. At other places which have been notorious for malaria the infection has practically disappeared at the end of three years through antilarval measures alone.

In a paper by Simmons, St. John and Reynolds[69] (1930) recording the results of a malaria survey at Fort Stotsenburg, P. I., a valuable observation was made of interest to those engaged in malaria surveys. *They call attention to the writer's observation*[70] *(1906)* that malaria at Stotsenburg was largely a family disease from which certain families suffered severely while others were free from infection. They confirmed these observations, finding that in the Philippines malaria is often a household disease not uncommonly affecting several members in a single family, and found that the results of a spleen survey of the children of a locality help to locate these malarious families and therefore facilitated the finding of carriers. They examined thick blood smears from ninety two persons living in eighteen families in each of which there was one or more children with enlargement of the spleen. They found that all of these suspected families had members who were carriers of malaria plasmodia. It was discovered that in this relatively small group of ninety two persons twenty four children had enlargement of the spleen, twenty eight individuals had been previously treated for malaria, and sixty two individuals or 67.4 per cent were carriers of the plasmodia. They therefore recommend that in a survey the families to whom children belong who show enlarged spleens be first examined and that this will greatly facilitate the determination of the actual parasite index of the locality.

The importance of the house as a nidus of malarial infection is considered by Lane[71] (1931) in a publication of the League of Nations Health Organization. He gives a *very valuable summary and discussion of the* relation of houses to the spread of malaria. After reviewing very carefully the literature upon the subject he concludes that investigations show that the house is a factor of *primary importance in the acquisition* and spread of malaria. Malarious houses are well known to occur in which the inhabitants all, or nearly all, contract malaria, and he calls attention to the fact that *in Bombay Anopheles stephensi breeds in the* houses. Not only does this occur but the insects may remain in the house indefinitely and may become infected and transmit the infection to the inhabitants. He *recommends screening and the killing of mosquitoes* in houses, and quotes the results obtained in the Canal Zone by application of these measures.

A great deal of interest has centered within the past year upon the influence of the administration of plasmochin as a prophylactic measure. In 1928 Barber, Komp and Newman published their researches regarding the effect of small doses of the drug on the viability of gametocytes. Their experiments apparently proved that single doses as small as 0.2 mg. per kg. of body weight affect the vitality of gametocytes of *P. falciparum* even though they were still living and capable of exflagellation, and that such gametocytes were not infective to mosquitoes. In 1929 Whitmore, Roberts and Jantzen[3] continued these observations and found that a single dose of plasmochin of about 0.325 mg. per k. body weight rendered the gametocytes non-infective to mosquitoes but he did not confirm Barber and Komp's observation that a single dose of 0.2 mg. *per kg. of body weight rendered the gameto*cytes sterile. Since these observations were made a number of investigators have employed plasmochin as a prophylactic drug in malarial localities. Mac*phail*[4] *(1930) in Guatemala employing* a dosage of three centigrams daily for six days combined with two grams of quinine found that gametocytes disappeared in from four to five days at most and that no toxic symptoms occurred. *He concludes that plasmochin effectively destroys the gametocytes of all forms of ma*laria when given in doses of three to four centigrams daily for one week and that combined with quinine it is a safe and sure way of preventing the formation of gametocytes during an acute attack of malaria. He further concludes that toxic symptoms need not be feared when the dosage is limited to three centigrams and that in the hands of a competent sanitarian plasmochin is a valuable aid in reducing the incidence of mosquito infection.

Brosius[5] (1930) in an interesting paper discusses the value of plasmochin in sanitation and concludes that the drug has a decided value in communities where there is a comparatively limited turnover in labor and where the treatment for the sterilization of gametocytes in the carriers can be repeated at given interval.

A paper dealing with the use of plasmochin in subtertian malaria by Ames[6] (1930) is of interest and value as it gives the comparative results obtained in the treatment of eighty four patients suffering from an acute attack of subtertian malaria with twenty grains (1.3 gm.) of quinine hydrochloride and two thirds grain (0.04 gm.) of plasmochin daily for ten days as compared with twenty patients given this same amount of quinine but no plasmochin. The object was to ascertain what if any difference occurred in the two groups of patients as regards the appearance and duration in the blood of gametocytes. Thick blood films were taken from each patient daily and examined. The author states that of a total of fifty nine patients taking quinine and plasmochin who were free from gametocytes on admission to the hospital gametocytes appeared later in the peripheral blood of twenty one or 36 per cent but were in most cases much smaller in number than developed in the control patients who received only quinine. He states that all of these patients were free from gametocytes on the tenth day of treatment with plasmochin and quinine and 88 per

modia and that experience is essential in the successful diagnosis of the malaria plasmodia

Within recent years efforts have been made to perfect some serologic method of diagnosis for the malarial infections The work of Thomson and Thomson [7] of Thomson [8] and of Horowitz and Wlassowa[59] upon complement fixation already mentioned and that of Taliaferro and Fisher[60] and Taliaferro[61] who have endeavored to perfect a precipitin test which would be useful in diagnosis are the outstanding attempts that have been made to obtain a serological test for malaria The results up to the present time have been very significant but it cannot be said that at present either complement fixation or precipitin tests are of actual practical value in the diagnosis of malarial infection

In 1929 Henry[62] described a method of diagnosis consisting of a flocculation serum test the antigen used being preparations of iron and suspensions of choroidal pigment A photometer is used in reading the reactions and with these antigens he obtained some encouraging results In 1930 Pozzi[63] tried the methods in 115 malarial patients and 25 controls suffering from various diseases He obtained 95 per cent positive results during apyrexial periods 185 per cent between attacks and 85 per cent negative during the fever While these results appear to be very favorable *Vialette and Remontet*[64] *state that the reaction persists* long after the disappearance of the malaria parasites and all other signs of malaria They examined 100 Senegalese soldiers natives of Central and West Africa 65 of whom gave positive reactions although the blood showed no parasites and they gave no history of malaria since childhood From these results it would appear that the test is valueless as showing present infection

An intracutaneous diagnostic reaction for malaria has been described by Herrmann and Lifschitz[65] (1930) As antigen they employed watery extracts of blood clot from cases of acute malaria using horse blood clot as a control For use the antigen was diluted 1 10 000 and 1 100 000 and the control 1 10 000 *with normal saline One tenth of a cubic centimeter* was injected intracutaneously on the inner side of the forearm with a fine needle Positive reactions were indicated by a papule 2 to 3 mm in diameter developing after 24 to 48 hours If the papule is smaller the reaction is called a weak positive A negative result is indicated by a complete absence of inflammation These investigators tested 105 persons of whom 67 were chronic malaria cases without plasmodia in the blood and 38 cases with different species of plasmodia in the blood They obtained strongly positive results in 63 or 60 per cent and weak positive results in 67 In all they consider that positive results were obtained in 85 7 per cent Of the negative cases 7 had fever at the time of the test and 3 were suffering from other infectious diseases. The test was negative in all healthy persons and the few that were suffering from other diseases that were tested These results appear encouraging but have not been confirmed as yet

(3) PROPHYLAXIS AND TREATMENT OF MALARIA

(a) *Prophylaxis*—The great bulk of the literature upon malaria during the past year has related to the questions of the prophylaxis and treatment of these infections A large number of papers have appeared giving the results of various prophylactic methods in various localities but few of them are of more than *local interest* While no discoveries have been made that affect the fundamental principles upon which prophylaxis against malaria is based it has become more evident that no one method of prophylaxis should be used to the exclusion of others unless local conditions warrant such usage In a recent publication of the League of Nations Health Organization[66] (1927) the matter is well summed up in the statement that

> Of the measures employed for the prevention of malaria there is no one that can be said to be the method of unquestioned choice local conditions governing the method or methods of prophylaxis to be adopted

Despite this wise attitude a more or less heated controversy is raging as to the relative value of the prophylactic measures recommended by James and his follower and those who believe that all prophylactic measures should be directed toward the elimination of the breeding places of mosquitoes or the destruction of their larvae In a correspondence published in the *British Medical Journal* Watson[67] (1930) states that after twenty nine years experience with malaria in the tropics his conclusions are directly opposite to those of Colonel James and that the effects of diet, housing economic status and general sanitation are practically negligible while attention to antilarval measures alone produces the best results It will be remembered that Colonel James urges special attention in prophylaxis to the destruction of adult mosquitoes in houses believing that this measure alone will greatly reduce the incidence of malaria in an endemic locality This method of prophylaxis had been urged by numerous investigators before it was considered by James and was one of the methods early adopted upon the Canal Zone in the general measures for the prevention of malaria There is no doubt that malaria is often a house disease as it has been the experience of nearly all observers that often several members of a family are infected in regions where malaria is intense but however important the destruction of mosquitoes in houses may be in prophylaxis such measures should not take the place of measures directed toward the prevention of the breeding of mosquitoes or the destruction of the larvae in the opinion of the vast majority of malariologists It certainly is a fact that the greatest decrease in malaria in almost every locality has been brought about by antilarval prophylaxis

A very excellent illustration of what can be accomplished through antimosquito measures is detailed in the paper by Hackett[68] (1929) upon malaria control in Italy This work was done at the malaria experiment station under the auspices of the Rockefeller Foundation and the Italian Government The object was to reduce malaria if possible by simple and inexpensive

diversity of opinion regarding these questions by many authorities and concludes that in the case of *Plasmodium vivax* the evidence very strongly supports the view that variations in the strain or virulence of this parasite do exist. However he is very doubtful that quinine resistant strains exist and states that a search for such quinine fast forms in northern India covering nearly 4,000 cases failed to reveal a single case in which the plasmodia were resistant to quinine.

During the past year a large number of papers have appeared in which the value of plasmochin or a combination of plasmochin and quinine is considered. Space forbids the consideration of most of these papers at this time but that by Major Manifold[31] (1931) Royal Army Medical Corps is probably the most important that has appeared to date. Manifold details the results of a study of the treatment with plasmochin and quinine in thirty five hospitals under the control of the Royal Army Medical Corps in India. The same treatment was used in all and consisted of one tablet containing 0.02 gm. of plasmochin and 10 grains of quinine given morning and evening for twenty one days. Only infections with *Plasmodium vivax* were treated.

In all 3,187 cases completed treatment while twelve patients among British troops and fourteen among Indian troops had to stop the treatment on account of toxic symptoms. Treatment had to be temporarily stopped in 21.4 per cent of the 1,298 British troops and in 10.2 per cent of the Indian troops but in most of these patients the toxic symptoms were said to be mild and continued experience with the drug resulted in fewer and fewer such cases.

Epigastric pain and colic occurred in 14.4 per cent of the British patients and 7.9 per cent of the Indian. In most cases the pain was slight and disappeared after cessation of treatment for a day or two. Vomiting was very unusual and abdominal pain slight.

Cyanosis occurred in 56 of the 1,298 British (4.3 per cent) and 13 of the 1,915 Indian patients (0.67 per cent). This symptom occurred in 80 per cent of the patients on or after the seventh day of treatment and cleared up in forty eight hours after cessation of treatment in 55 per cent and in seventy two hours in 80 per cent of the British cases. One death was reported. Dyspnea occurred in only two cases, diarrhea in ten cases while cardiac symptoms were negligible and not so frequent as might be expected with quinine alone. Albuminuria occurred in five cases.

Manifold concludes that the dosage of plasmochin used may be safely given to all classes of patients provided they are kept under observation during the three weeks of treatment. He considers that the incidence of severely toxic symptoms is small and that such symptoms are of importance in only a very few patients who have a special idiosyncrasy to the drug. After a temporary cessation of the treatment for a day or two he states that it can be continued in the great majority of cases for the required period.

The relapse rate after this method of treatment he found to be very low in patients observed for an average period of four and a half months. In such patients the relapse rate was 5.2 per cent but if relapses were counted only after the end of the malarial season it was only 2.4 per cent. He quotes Sinton, Smith and Pottinger[8] (1930) who obtained a relapse rate as high as 42 per cent in a series of quinine treated cases but when they used the same treatment which Manifold used in this investigation the relapse rate was reduced to 8 per cent. Manifold concludes with the suggestion that further work may demonstrate that good results may be obtained with much smaller doses than 0.04 gm. of plasmochin daily and this might make it possible to issue the drug to patients not under medical supervision.

In the paper previously mentioned Sinton, Smith and Pottinger as a result of observations with the treatment of malaria by plasmochin and quinine conclude that this combination is better than either drug separately and Sinton[39] in an excellent paper devoted to the treatment of malaria reaches the following conclusions regarding the use of plasmochin: Plasmochin used alone is of little use in the treatment of malignant tertian malaria, has a marked action in producing both clinical and permanent cures in benign tertian malaria but its good effects are much increased by a combination with quinine. It has a rapid destructive and sterilizing effect on gametocytes of all species of malaria plasmodia. The maximum daily dose should not exceed 0.04 gms. (about 2/3 grain) and the treatment should always be carried out under medical supervision and stopped upon the appearance of any toxic symptoms. The drug should not be given to persons suffering from lesions of the liver, kidneys or circulatory system or to weak and anemic individuals. At present our knowledge does not warrant the use of this drug on a large scale in the dosage originally recommended, but it is a very important adjuvant to quinine in the treatment of malaria and should always be given in combination with the latter drug.

In this paper Sinton recommends three standard treatments for malaria that are of interest and he uses two mixtures in these routine treatments. Mixture A or the alkaline mixture has the following composition: sodium bicarbonate 4 gm. (60 grains), sodium citrate 2.6 gm. (40 grains), calcium carbonate or chloride 0.2 gm. (3 grains) and water to make 28.5 c. c. or one ounce. This mixture should be well shaken before using. Mixture B or cinchona mixture: quinine sulphate (or cinchona febrifuge) 0.65 gm. (10 grains), citric acid 2 gm. (30 grains), magnesium sulphate 4 gm. (60 grains), water to make 28.5 c. c. (one ounce). Of the three treatments Treatment I is recommended in acute primary infections. After a preliminary purgation 1 oz. of mixture A is given, repeated in one hour and again repeated after one hour. About one half hour after the third dose of mixture A one ounce of mixture B is given and one ounce of mixture A is given one half hour before every subsequent dose of mixture B.

Mixture B is given three times daily for one week

cent were free on the seventh day He concludes that plasmochin combined with quinine does not prevent fully matured gametocytes from appearing in the peripheral blood but that gametocytes in the early stages of development are destroyed Of the twenty control patients who received only quinine twelve or 60 per cent showed gametocytes in the peripheral blood as compared with 36 per cent in those taking plasmochin These studies apparently show that the sexual forms of *Plasmodium falciparum* may appear in the peripheral blood in spite of continuous treatment with plasmochin but that from seven to ten days treatment is sufficient to cause their disappearance

Amies also examined 2 420 anopheline mosquitoes which were bred from larvae in the laboratory in order to ascertain the effect of plasmochin on the viability of the gametocytes of *Plasmodium falciparum* The mosquitoes were allowed to bite gametocyte carriers daily and the salivary glands of the insects were examined fifteen days later for evidence of infection The results he obtained indicate that a gametocyte carrier is rendered uninfective to mosquitoes after taking 0 04 gm (2/3 grain) of plasmochin and that he remains uninfective for at least three days He confirmed the findings of Barber Komp and Newman in that his results indicated that two doses each of 0 02 gm (1/3 grain) of plasmochin given with an interval of sixteen hours between will render non viable all the gametocytes in the blood of a carrier He also found that if the plasmochin is given on every fourth day it produces the same results so far as preventing mosquito infections as giving of the same dose every day He therefore recommends that in the treatment of malaria this amount of plasmochin be given in two doses on the first fourth seventh and on day of treatment He believes that this treatment will prevent the development of gametocytes or render those that do develop sterile

The general consensus of opinion of those who have investigated the subject of the effect of plasmochin upon gametocytes is that this drug has a very powerful action upon these sexual forms can be used to advantage in the prophylaxis of malaria and that the small doses that are efficient do not produce toxic symptoms It would appear that continued observations should be made upon this most important phase of malarial prophylaxis as the data available are based upon comparatively small numbers of individuals and while the evidence of the value of the drug in this direction is apparently conclusive further observations upon larger numbers of individuals are needed

A suggestive paper upon the practical research value of mosquito traps by Bath[77] (1931) has appeared in which he urges the use of his mosquito trap in prophylaxis and also for the purpose of research work upon the incidence of mosquitoes and other insects He states that Dr Clark Director of the Gorgas Memorial Laboratory recently used several mosquito traps for capturing anopheles mosquitoes in unsanitated areas near Panama City and that at the date of writing his paper eleven of these traps had caught 49 496 anopheles in thirty two days In one night one trap captured 4 973 anopheles The traps are not only useful in capturing mosquitoes but many other insects as well so that Bath believes that the mosquito trap will prove of great value in research work upon the incidence of insects in any locality He calls attention to the fact that if the anopheles captured in the traps mentioned had lived to deposit one batch of eggs each 4 949 000 anopheline mosquitoes would have been the result

No important paper dealing with the question of quinine prophylaxis has occurred within the period covered by this review It appears to be the consensus of opinion at this time that while quinine given in the usual amounts will not prevent malarial infection if given in sufficient dosage it will prevent the development of symptoms and that if therapeutic doses are employed the infections can be cured without the development of symptoms Quinine prophylaxis is not considered today as a method that should be used to the exclusion of other and better methods but under certain conditions as in movements of troops in malarial districts or traveling or camping in such districts quinine prophylaxis should be employed

(b) *Treatment*—Most of the literature during the period under review has dealt with the relative value of quinine and plasmochin in the treatment of malarial infections Bass[78] (1930) states that he considers that the cinchona alkaloids especially quinine are our only specific remedies for malaria While he admits that therapeutic results can be obtained with the arsenicals plasmochin and other quinine substitutes he does not believe that their use should replace quinine or that the results obtained, because of the toxicity of these drugs are worth the price paid

Sinton [9] (1931) concludes that the number of permanent cures produced by quinine is increased by prolonged courses of treatment and that such cures follow the administration of larger rather than smaller doses of the drug He recommends thirty grains of quinine a day for one week for the treatment of all primary malarial infections and that precautions should be taken to see that the drug is absorbed He makes the following statement which is rather surprising Such treatment, if properly carried out should cure at least 70 per cent of fresh malarial infections ' One cannot help but believe that the author is too optimistic for it is very doubtful that one week s treatment of even primary infections with the dosage of quinine recommended will cure such a large percentage of cases

The question of the occurrence of quinine fast strains of the malaria plasmodia is still attracting attention The evidence as to the existence of such strains is up to the present absolutely unreliable and will not bear close analytical study The most recent contribution to this subject is that of Sinton[80] (1931) who discusses the question of variation in virulence of different strains of the same species of plasmodium and the existence of quinine fast strains He instances the great

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THE 1930 STATUS OF MALARIA IN THE SOUTHERN UNITED STATES AS DETERMINED BY MORTALITY DATA*

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INTRODUCTION

After making a tour of the southern United States a distinguished foreign malariologist once remarked that there was no malaria problem here we were merely annoyed by mosquitoes While there are at the present time no such vast areas of intensive infection with malarial organisms as have in the past been recorded from French Indo-China Siam the Malay Peninsula, Java and Sumatra, a careful examination of the 1930 mortality rates for fourteen Southern states indicates that there is most certainly a malaria problem in our midst.

Mortality data by states as a whole while indicative

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preceded each time by a dose of mixture A as directed. In addition to this the patient receives ¼ grain (0 015 gm) of plasmochin once daily during the week he ■ on the quinine treatment. This treatment ■ though lasting only one week Sinton claims has a rapid action on the clinical manifestations of all three types of malaria destroys or makes non viable the sexual forms of all three forms of the parasite and should permanently cure at least 80 per cent of all malignant tertian infections and probably more than 70 per cent of primary infections of benign tertian as well as 20 or more per cent of the chronic infections Not more than 20 to 30 per cent of benign tertian infections should relapse after this treatment

Treatment II is used in relapsing infections and if the relapse is due to malignant malaria Treatment I should be repeated for one week and the quinine and alkaline treatment continued but only twice daily for another week with no plasmochin If the relapse is due to benign tertian malaria or a mixed infection Treatment I should be repeated as for relapses of malignant tertian malaria but the daily dose of plasmochin may be raised to 0 02 gm (1/3 grain) during the fourteen day course of treatment

If a relapse occurs after this treatment due to malignant tertian malaria Treatment II is repeated if due to benign tertian or quartan Treatment III is given. This consists of the administration of the quinine alkaloid dosage described in Treatment I for one week combined with a total daily dosage of / to 2/3 grain (0 03 0 04 gm of plasmochin) administered in two divided doses after meals. During the following two weeks, mixture B is given twice daily with a similar dose of plasmochin

Sinton states that as the result of his experience with these various methods of treatment he estimates that Treatment I should cure roughly 80 per cent of all the ordinary forms of malaria seen in general practice irrespective of the plasmodium involved Treatment II should cure another 10 per cent of the total leaving about ■ per cent of chronic benign tertian or quartan and about 1 per cent of malignant tertian of which practically all the latter should be cured by repeated treatments Treatment III was designed to cure the remaining chronic benign tertian and quartan infections

Although numerous other papers have appeared upon the efficiency of plasmochin in the treatment of malaria the consensus of opinion appears to be that this drug is useful in combination with quinine but that its administration must be carefully guarded owing to the frequency of toxic symptoms It appears to be of great value in the destruction of gametocytes of all three species of plasmodia and those who have used it most extensively are unanimous in the statement that the relapse rate in all forms of malaria ■ greatly reduced where it ■ used in combination with quinine

One of the great difficulties attending the treatment of malaria with quinine ■ the uncertainty as to whether the drug as administered ■ being absorbed Even though it may be detected in the urine by easily applied tests this does not prove that enough of the drug has been absorbed to cause the destruction of the plasmodia Vedder and Masen[84] (1931) describe two new methods of practical value in the determination of the amount of quinine in the blood and give the results they obtained by the application of these methods The methods can be used ■ a guide to the amount of quinine to be administered in the treatment of malaria by demonstrating the concentration of the drug in the blood They found that the concentration of quinine in the blood depends upon individual variations as after the oral administration of ■ grains one individual may have only 2 mg per liter in the blood and another 5 mg per liter The authors regard these variations as the probable reason why a standard treatment will cure one individual while another will relapse One patient ■ cited suffering a tertian relapse who after the administration of 30 grains of quinine in three 10 grain doses showed as the highest concentration obtained on the second day 4 6 mg per liter with no symptoms of cinchonism The same patient when placed upon 40 grains of quinine a day developed a concentration in the blood of 75 mg per liter at which time he had severe ringing in the ears The authors believe that the standard treatment of 30 grains daily would never cure this patient owing to lack of sufficient concentration of the drug in his blood. Their observations appeared to demonstrate that the administration of quinine by mouth is the best method and that there is no excuse for intramuscular injections which are more slowly absorbed and produce tissue necrosis

Knowles Senior White and Das Gupta[85] (1930) recommend the Bass method of cultivation of malaria plasmodia in determining whether parasites are present in the blood after treatment In four cases where daily blood films had become negative cultures showed parasites still present and in one instance a positive culture was obtained in a patient who had received 140 grains of quinine in solution in 7 days They recommend the use of this method in the determination of a cure

A most useful method of preserving malaria plasmodia when it is desired to transmit these parasites through the mail for the purpose of treating paretics ■ described by Johns[86] (1931) The method consists in the addition to each 10 c c of blood of 0.2 c c of a 50 per cent sterile solution of dextrose defibrinating the blood and storing the defibrinated blood in cracked ice Successful infections were obtained with blood kept in this manner for as long as 18 days and such blood has been transported from New Orleans to Los Angeles Jacksonville Denver Chicago and other places and used successfully in inoculation of paretics Johns concludes that the infectivity of this blood for eight days is fully equal to that of blood directly transferred from patient to patient

The most important monograph upon malaria published during 1931 ■ that by Boyd[87] entitled An Introduction to Malariology which contains most valuable data upon the subject with special reference to the biology of both the plasmodia and the mosquito vectors malaria surveys and prophylaxis.

number of counties with a rate of 10 or more has decreased by 9 or 9 5 per cent within this period.

Mississippi—Of the 82 counties in the State all but 13 (15 8 per cent) recorded deaths from malaria in 1930 Eighteen (21 9 per cent) of the positive counties returned a rate of more than 20 although only one (Tunica County) had a rate exceeding 50 (61 2) Except for the Mississippi Yazoo Delta region where a block of ten counties has a rate in excess of 20 the remaining counties of heavy endemicity are scattered northeast southeast and coastal The average rate for the State in 1930 was 13 9 the lowest figure reached in Mississippi's fight against the infection During the past decade the net decrease in the number of counties with a rate of 10 or more amounts to 63 or 76 9 per cent

Alabama—Of the 67 counties in this State only 9 (13.3 per cent) were without deaths from malaria in 1930 Sixteen counties (23.8 per cent) had a rate exceeding 20 and two (Greene and Houston Counties) had a rate slightly more than 50 The regions of heavy infection lie between the Tombigbee and Alabama Rivers and in the lower valley of the Chattahoochee The average malaria mortality rate for the State for 1930 was 11 27 a decrease from 1929 and approximately the same as for the year 1928 but in excess of the 1923 1927 rates. Within the past ten years there has been a net increase amounting to fourteen or 20 9 per cent in the number of counties with a malaria death rate of ten or over

Georgia—Of the 161 counties in this State 96 (59 6 per cent) had deaths recorded as due to malaria in 1930 Forty seven of these (29 2 per cent) had a rate exceeding 20 thirteen (8 1 per cent) in excess of 50 four in excess of 100 and one (Jenkins County) had the exceedingly high rate of 08 Practically all of the severely endemic region stretches through the lime stone belt from the southwestern corner northeastwardly toward the South Carolina line The extreme north and the extreme south are essentially without heavy foci The average rate for the State for 1930 was 15 2 a lower level than for 1928 or 1929 but considerably in excess of the years 1925 1927 Since 1921 54 counties have shown an increase and 40 counties a decrease in the malaria mortality rate exceeding 10 per 100 000 making a net increase of 14 counties

Florida—Of the 67 counties in this State 50 (74.6 per cent) recorded death due to malaria for the year 1930 Thirty four of these (50 7 per cent of the whole group) had a rate exceeding 20 fourteen (28 4 per cent of the total) had a rate between 50 and 100 four (Citrus, Jefferson Levy and Wakulla Counties) ranged between 100 and 200 and one (Dixie County) reached the 1930 peak for the United States with a rate of 300 per 100 000 This last although computed for a relatively small area exceeds the 1927 1929 rate by 50 per cent and compares with the rates for the swamp areas of southeastern Missouri some twenty years ago. These areas of heavy endemicity are all in the lower drainage of rivers flowing into the Gulf but particularly in the lower Sewanee Valley The average rate for the State for 1930 was 21 67 which indicates a 50 per cent decrease from 1928 and 1929 but a slight increase over the 1925 1927 period On the whole there has been no marked change in Florida during the past decade Within the decade the net number of counties showing a malaria death rate of 10 or over has increased by 5 or 7.5 per cent

South Carolina—Of the 46 counties in this State 33 (71 7 per cent) had malaria deaths recorded for 1930 Eighteen of these (39 1 per cent of the total) had a rate exceeding 20 eight (17 4 per cent of the entire group) had a rate above 50 and 2 counties (Beaufort and Berkeley) had a rate in excess of 100 (174 42 and 144 0 respectively) All of these counties which are heavily malarious lie in the lower coastal drainage plain of the Atlantic Comparable to Beaufort in situation however is Charleston County with a malaria mortality rate of only 16 66 or approximately one tenth of the former county The average rate for the State is 19.26 a figure slightly lower than those for 1928 1929 but nearly twice that for the minimum year of 1925 (rate 10 7) Since 1921 there has been a net increase of 5 (10 8 per cent) in the number of counties with a malaria death rate of 10 or more

North Carolina—Of the 100 counties in this State only 26 reported deaths from malaria in 1930 and only one (Washington County) had a rate in excess of 20 (25 8 based on three deaths) The rate for the State as a whole for 1930 was 1 4 the lowest in the State's malaria records and less than one fifth of that of the years preceding 1921 Altogether there has been a net decrease of 23 (23 per cent) in the number of counties showing a rate of 10 or more

Virginia—Of the 100 counties in this State 13 reported deaths from malaria for the year 1930 Only one (Middlesex County) had a rate in excess of 20 (27 4 based on two deaths) The rate for the entire State for 1930 was 0 62 slightly higher than the lowest record of 1928 but otherwise a minimum record and only one third of the rate for 1921 A net decrease of 3 counties having a death rate of 10 or more is recorded for this State during the past decade

DISCUSSION

In the area covered by this map there are altogether 1 243 counties of which 646 or 51 9 per cent reported deaths from malaria in 1930 Of these malarious counties 412 or 33 2 per cent had a mortality rate less than 20 per 100 000 168 or 13.5 per cent had a rate between 20 and 50 54 or 4.3 per cent had a rate between 50 and 100 and 11 or 0 9 per cent had a rate in excess of 100 per 100,000 population

In some counties and states the 1930 malaria mortality rate represents a slight increase over the 1928 or 1929 figures in other counties and states it shows a satisfactory decrease On the whole the picture presented for 1930 is fairly indicative of the present status with respect to malaria in our Southern states. A comparison with the figures of Maxcy (1923) for 1919 1921 for this area indicates the following trends

of trends in the control of the disease are not satisfactory since they do not designate the more circumscribed areas where heavy foci of the infection exist. For this reason and in order that a clearer picture of the existing conditions may be obtained, the writer has secured mortality data by counties for this whole area and has represented this situation graphically on an enlarged map. These data have been made available through the health officers of the respective states, to whom the writer desires to express his most sincere thanks.

In order to visualize the areas under control and those of mild endemicity as well as the foci of heavy infection, the simplest type of legend has been employed, namely, white for those counties where no deaths due to malaria were recorded for the year 1930, small dots for the counties with 20 or less deaths recorded, and successively larger dots for the 20 to 50, 50 to 100 and 100 to 200 groups, while solid black indicates a mortality of more than two hundred per 100,000. The counties are numbered by states in alphabetical sequence with the exceptions of Texas, where such sequence applies only to the counties in the eastern part of the State, including only those shown on the map, and of Missouri, where only the southern three tiers of counties are shown.

DATA PRESENTED

An examination of the map indicates that more than half of the counties in the southern United States show some mortality, that no small portion of these has a mortality rate of more than twenty per 100,000, that sixty six counties in the area have a mortality rate of more than fifty, that twelve counties have a mortality rate of more than 100 and that two counties have a rate of more than 200, of which one of the latter stands at 300. Surely these figures are not insignificant.

It will be advisable now to present the data by states, working from west to east.

Oklahoma.—Of the 126 counties in this State 37 (29.3 per cent) had recorded deaths from malaria in 1930. Eight of these had a rate of more than twenty. The majority of the malarious counties border the *Arkansas River* and its *tributaries*. *The rate for the* entire State was 5.27. The rate has not changed perceptibly within the past five years, although there has been a net decrease within the decade of 5 counties (5.4 per cent) showing a mortality of 10 or more per 100,000.

Texas.—Only the eastern half of this State is shown on the map. Of the 159 counties represented 77 (48.4 per cent) had recorded deaths from malaria in 1930. Eighteen of these had a rate of more than 20 for the 1929-1930 interval. The majority of the more heavily infected counties are in the northeastern part of the State with drainage into the Red River and Sabine River. Only four counties in the western half of the State had malaria deaths during 1930 and only four for the preceding year. The rate for the State as a whole in 1930 was 5.52, which is essentially the same figure as ten years ago, although a low of 3.8 was reached in 1923 and again in 1927. Within the past ten years there has been a net decrease of 6.1 per cent of the counties showing a malaria death rate of 10 or more per 100,000.

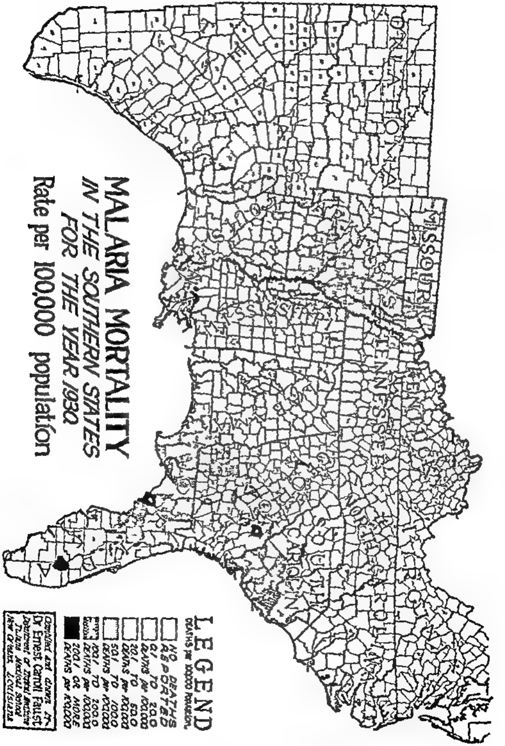
Arkansas.—Of the 75 counties in the State all but seven (9.3 per cent) had recorded malaria deaths in 1930. Of these 45 (60 per cent of the entire State) had a rate over 20, twenty (26.6 per cent) had a rate over fifty and one (Phillips County) had a rate of 125. The rate for the entire State for 1930 was 36.3, the same figure as for 1929 (36.2) and essentially the same as for the past ten years. This is the highest rate for any state at the present time. Within the past decade 35 counties have shown an increase above 20 per 100,000 and 11 counties a decrease, with a net increase of significant deaths in 7 counties (9.3 per cent). The heavy spots occur along the St. Francis, White, Arkansas, Ouachita and Red Rivers, particularly where the first four converge to enter the Mississippi River.

Louisiana.—Of the 64 parishes in the State 48 (75 per cent) had recorded malaria deaths for 1930. Only eight (12.5 per cent), however, had a rate above 20 and none as high as 50. (33.5 for Madison Parish was the highest record for the year.) With few exceptions malaria has decreased year by year in Louisiana and in 1930 the average rate for the State was 8.5, or only one fourth of that for 19 0. The more severe foci of infection are found along the Red and Tensas Rivers, while the rice growing parishes and those along the southeast coast are now essentially malaria free. Altogether within the past ten years there has been a net decrease of the significant death rate in 47 parishes or 73.4 per cent of the parishes in the State.

Missouri.—Of the 33 *counties* in the southern three tiers in this State 14 (42.4 per cent) reported deaths due to malaria in 1930. Of these ten (30.3 per cent) were in excess of 10 per 100,000 and three (Butler, Dunklin and Pemiscot) were somewhat in excess of 50. In addition 11 counties farther north in the State reported one to six deaths from malaria during the year. As compared with 1919-1921 (Maxcy, l. c.) *5 counties showed an increase in the rate above 10* per 100,000 and 7 showed a decrease, making a net gain of 6.1 per cent.

Kentucky.—Only 25 of the 120 counties in this State had recorded deaths caused by malaria in 1930. Of these only three had a mortality rate over 20. These latter are situated in the extreme western part of the State adjacent to the Ohio and Mississippi Rivers. The rate for the State as a whole for 1930 was 2.1. An increase of 3 counties with a significant death rate has occurred within the decade.

Tennessee.—Of the 95 counties in the State 32 (33.6 per cent) had recorded deaths due to malaria in 1930. All of the counties with a rate over 20 (10 or 10.5 per cent) are situated between the Mississippi and the Tennessee Rivers. The average rate for the State was 5.4 in 1930, which shows a continued decrease in the rate since 1921, when the average was 15.2. The net


MALARIA MORTALITY
IN THE SOUTHERN STATES
FOR THE YEAR 1930
Rate per 100,000 population
OKLAHOMA
MISSOURI
MISSISSIPPI
TENNESSEE
LEGEND
DEATHS per 100,000 population
NO DEATHS AS REPORTED
0.1 TO 20.0 DEATHS per 100,000
20.1 TO 50.0 DEATHS per 100,000
50.1 TO 100.0 DEATHS per 100,000
100.1 TO 200.0 DEATHS per 100,000
200.1 OR MORE DEATHS per 100,000
Compiled and drawn by
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(1) A decrease in the rate has been made on the Oklahoma side of the Red River valley although the infection appears to be considerably more widespread in Oklahoma than it was a decade ago The same conclusions apply to coastal Texas

(2) With respect to intensity southeastern Missouri and Arkansas show a satisfactory reduction although more counties in Arkansas reported deaths from malaria in 1930 than are indicated in Maxcy's data (1923) The Mississippi St Francis-White Arkansas Delta region is still a very important hotbed of malaria

(3) A marked decrease throughout all of the malarious districts of Louisiana is noted The control of the disease in northern Louisiana is particularly gratifying

(4) Malaria is somewhat more widespread in western Kentucky today than it was a decade ago

(5) Progress in the control of malaria in western Tennessee is relatively satisfactory

(6) Marked decrease in intensity of the disease is noted for the Yazoo Mississippi Delta region

(7) The situation in Alabama Georgia and Florida is essentially unchanged Effective control in these states still requires actual demonstration

(8) In the coastal region of South Carolina malaria is still a major public health problem

(9) In North Carolina gratifying diminution in the intensity of malaria deaths is noted although there is apparently a slight increase in the extent of the mortality records

(10) Except for Middlesex County on the lower Rappahannock River the situation in Virginia appears to be much improved

(11) The following states show a notable decrease in the number of counties reporting a malaria death rate of 10 or more per 100 000 Texas 36 (22.7 per cent) Louisiana 47 (73.4 per cent) Mississippi 63 (76.9 per cent) and North Carolina 23 (23 per cent) The following states show a slight decrease Missouri 2 (6.1 per cent) Oklahoma 4 (5.4 per cent) Tennessee 9 (9.5 per cent) and Virginia 3 (3 per cent) The following states show a net increase Alabama 11 (20.9 per cent) Arkansas 7 (9.3 per cent) Florida 5 (7.5 per cent) Georgia 14 (9.6 per cent) Kentucky 3 (2.4 per cent) and South Carolina 5 (10.8 per cent)

(12) A total of 214 counties (17.2 per cent) in the southern United States show a death rate from malaria of 10 or more for 1930 in excess of the 1919 1921 rates of these counties. On the other hand, 363 counties (29.1 per cent) which had a rate of 10 or more during 1919 1921 have a rate for 1930 of less than 10 This makes a net significant reduction of 149 counties (11.9 per cent) and may be considered as a rough estimate of the reduction which has taken place during the past decade

Maxcy (in a private communication) has indicated to the writer that it is not safe to draw any conclusions as to whether the disease has increased or decreased in a county on the basis of a single year's experience This is a logical deduction and merits careful consideration Two heavily malarious states, Arkansas and Florida for which data are available for the past five years, have therefore been examined and the mortality rate averages for the five year period 1926 1930 computed. In Arkansas 15 counties (20 per cent) have an average which varies somewhat from the 1930 rate Five of these counties have an average increase and ten have an average decrease varying from the 1930 figures In other words, the average rate is about 6.6 per cent more favorable than the 1930 rate In Florida the average rate for the five year period deviated somewhat in six counties (8.9 per cent) from the 1930 rate Two of these had an average increase and four had an average decrease varying from the 1930 figures, with a net favorable decrease of two (slightly less than 3 per cent) If comparable variations exist in the other states there will be evidence that more deaths from malaria per 100 000 population were recorded in 1930 than in the average year for the five year period. However this difference is not enough to affect significantly that comparison with figures which Maxcy compiled for the 1919 1921 period

Undoubtedly the more accurate diagnosis of the infection at the present time may also have influenced the number of recorded deaths in the area It is impossible to estimate whether more complete registration during more recent years and more accurate diagnoses would have influenced the mortality rate favorably or unfavorably

Unfortunately mortality data although the most accurate measure of malaria at the present time for any large registration area only provide an approximate estimate of malaria morbidity This is due to several causes, of which the most important is perhaps the fact that most of the deaths from malaria in the southern United States are probably due to infection with *Plasmodium falciparum* whereas *Plasmodium vivax* unquestionably has a wider distribution It is therefore necessary to recognize the limitations of any mortality statistics such as the writer has been obliged to utilize It is a matter of keen regret that there are not available for the entire area reliable morbidity data such as exist for limited areas where intensive studies have been carried on

GENERAL CONCLUSIONS

While satisfactory decreases have occurred in the mortality rate for malaria in certain regions of the Southern states there are extensive areas where the rate is essentially the same as it was a decade ago Although a decrease in the number of deaths has been effected in certain counties of certain states an increase in the counties reporting deaths due to the disease is reported In other states rates in excess of 10 per 100,000 population have apparently become more common than they were a decade ago There is abundant evidence to indicate that malaria is still a major public health problem in the southern United States

cussing my paper that mortality data certainly are a frail skeleton from which to draw conclusions. However they are the best we have and it will be interesting ten years from now to compare the mortality maps with those of 1930.

SOME RECENT INVESTIGATIONS OF THE VIABILITY AND LONGEVITY OF THE MALARIA PARASITE IN THE MOSQUITO AS RELATED TO MALARIA THERAPY OF PARESIS*

By Bruce Mayne, D.P.H., M.Sc.†
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In inducing malaria for therapeutic purposes the general method in vogue of transferring blood directly from one general paralytic to another is not infallible. The injection of blood is questionable when the diagnosis is not clearly defined. Some authorities object to using blood which comes from a paretic on account of the possibility of conveying foreign substances, neurotropic and other strains of syphilis. However remote the possibility, one may encounter a bacterial infection similar to that observed at one of the state hospitals. In this instance following the inoculation of blood in malaria therapy it was realized that the blood donor was suffering from a streptococcus infection which subsequently proved fatal. One of the three cases receiving the blood likewise succumbed to a similar bacteremia. The possibility, less remote, of having a mixed infection of malaria parasites was demonstrated from personal observation in three distinct centers of malaria therapy. In two hospitals fatal instances were noted as the probable result of confusing mixed parasites of malignant tertian and simple tertian. In another institution blood used to convey simple tertian malaria was observed to harbor both quartan and tertian forms, predominantly the former. All of this gives emphasis to the need for *conducting more of our malaria therapy* through the agency of anopheline mosquitoes, a method up to the present, however, far from the ideal and probably subject to more or less serious objections.

Recognizing the risk of infecting with two kinds of parasites at the same time the English authorities in 1925 inaugurated the inoculation of the paretic through the agency of mosquitoes. Since that time figures based upon results of treatment show that among more than three thousand patients over 20 per cent were improved enough to be sent home and approximately 12 per cent were considered permanently cured.

Of the modifications introduced into the treatment by the English workers the most important consisted in not stopping the fever after seven or eight attacks but allowing it to continue, modified if necessary by the judicious use of quinine, until the patient acquired tolerance for the parasite and the symptoms were not very marked. This modification is based on the hypothesis that the curative action of the malaria is not due to the fever alone but also and chiefly to the continued presence of the parasites and their toxins in the patient's body.

Another modification is the use of the pure quartan strain of parasite instead of the tertian, because this parasite causes high temperature without serious symptoms and may therefore be allowed to run for several weeks or even several months. Furthermore the use of the parasite of malignant tertian, that is, estivo-autumnal malaria, has been tried in about sixty cases in the hope that it will prove to be more active because of its tendency to sporulate in the central nervous system and other organs instead of the peripheral blood.

These modifications, particularly the allowing of the infection to continue up to the point of an acquired tolerance for the disease, are not only considered improvements in the application of malaria therapy for general paralysis, but they also furnish exceptional opportunity for the clinical and experimental therapeutic study of malaria.

In the course of undertaking malaria therapy by mosquito inoculations of patients with paresis conducted by the United States Public Health Service the methods employed at the present time are limited to personal transportation of infected Anopheles from one institution to another in iced containers and the limited application in the sending of mosquitoes by express to trustworthy workers in Government and state institutions. All of this centers about the potentiality of the mosquito as a carrier and a conserver of the infection for more or less limited periods. The interesting queries which arise are how long mosquitoes will carry infection and how many bites are required to infect a person. It is generally understood that mosquitoes may remain infected as long as they live. This has never been proved, *however, but it has been suggested in the* work of British authorities in England and in our own work here.

British investigators have actually carried mosquitoes with the malaria parasite in their hospitals for a period of ninety days and have kept mosquitoes alive fully six months for this purpose. They have found, however, that the mosquito gradually loses its infectivity after about ninety days. We have carried investigations to the point where we can confirm the work of the British authorities. It may be interesting to note that mosquitoes, following the technic in vogue at present, have been kept alive for the following periods: Anopheles 231 days, Culex 265 days. Forms indistinguishable from sporozoites have been found in the mosquito after 155 days, however in a condition not thought to be viable on inoculation. We have maintained the parasite alive in the mosquito for a period of 55 days. Experience in India gives us the informa-

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†Special Expert, U. S. Public Health Service.

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DISCUSSION (*Abstract*)

Dr F L Hoffman Newark N J—Dr Faust has pointed out to us that there are states like Arkansas in which as many as 91 per cent of the counties are affected by malaria while the proportion runs as low as 13 per cent in Virginia The present picture however is in marked contrast to the past for in former years the entire Atlantic coastal plains of the Southern states were heavily infected while now large areas are comparatively free from the disease But the malaria problem in the South is still one of vast extent and of considerable complexities There are still areas where the mortality may reach as high as 200 per 100 000 corresponding somewhat to the heavily infected areas on the west coast of Africa I agree with Dr Faust that the present day trends of malaria are not suggestive of successful control and that much requires to be done But the disease must be studied with particular reference to specific localities and sections rather than by states as a whole

For some of the states the conclusions of Dr Faust are rather disconcerting In Oklahoma for example the disease has spread considerably during recent years, and the same is true of the coastal plains of Texas In the lowlands of Mississippi and Arkansas the disease is still exceedingly common In Louisiana however there has been a marked decrease in all the malarious districts In western Kentucky the disease is now more common than it was ten years ago but the control of the disease in western Tennessee is apparently successful A very marked decrease in intensity is noted for the Mississippi Yazoo Delta region The situation in Alabama Georgia and Florida remains apparently unchanged In the coastal region of South Carolina malaria is still a major health problem but happily considerable progress has been made in North Carolina where formerly the disease was extremely common in the coastal plains With the exception of a few counties the situation in Virginia is apparently under control

The conclusions of Dr Faust support my own investigations extending over many years I also in season and out have emphasized the urgency of thoroughgoing malaria surveys to localize the intensity of the disease and the sources of infection The excessive incidence of malaria requires to be taken much more seriously than has generally been the case, since malaria complicates deaths from many other causes especially diseases of the renal organs

Dr K F Maxcy University Va—I have been very much interested in Dr Faust's analysis of the 1930 malaria mortality figures in comparison with those of 1919 1921 Mortality reports furnish the only data available unsatisfactory though they be for a general survey of the malaria situation in the southern United States. While accurate surveys by means of blood and spleen indices have been conducted in many localities, they afford no basis for generalization

There is no doubt that mortality rates based upon the county as a unit of population can be used in a rough way to mark out the geographic distribution of the disease and to indicate the areas of relatively high low or questionable prevalence Intensive field studies of limited localities have in a general way supported the inferences made in the 1919 1921 analysis of county malaria rates

On the other hand as experience has accumulated it has become increasingly evident that the errors of malaria death registration due to degree of completeness, due to inaccuracies of diagnosis and due to the chance variation of small numbers when the county is used as a unit of population are so imponderable as sharply to restrict the use of the data

For example where Dr Faust has noted an increase or a decrease in the malaria mortality rate of a county in 1930 as compared with 1919 1921 the difference is due to an indeterminate degree to the errors mentioned It does not necessarily imply a corresponding increase or decrease in intensity or prevalence of the disease His observations with regard to the more widespread distribution of infection in Oklahoma coastal Texas and western Kentucky may be due largely if not entirely to the improved registration of deaths which is known to have taken place during this period Such changes as have been mentioned in registration of deaths are particularly apt to occur in counties in which there has recently been established a full time health organization

In view of past experience American workers can well afford to be cautious and conservative in the use of malaria statistics County mortality figures can be used to block out the extent of the problem in a rough way but small differences do not warrant statements as to the increase or decrease of the disease without knowledge of the local situation

Finally I hope that Dr Faust will not think me too argumentative if I beg to disagree with his final statement that malaria is still a major public health problem in the southern United States I would qualify that statement to the effect that malaria is still a public health problem of major importance in certain limited localities of the southern United States which are now well known The great majority of people and most of the land area of this section are as safe from malaria as are the people and land in the northern United States

Dr H E Meleney Nashville Tenn—Although it is well recognized that mortality statistics have a limited value in estimating the amount of malaria in a region they have somewhat greater value in comparing the amount of malaria present in different regions having the same general environmental conditions In Tennessee it was found that the mortality rate from malaria in the counties bordering on the Mississippi River correspond with but one exception with the morbidity rate as indicated by county wide blood surveys of the school children Dr Faust has used only one year in presenting his figures on malaria mortality in the southern United States and the year which he chose 1930 being a drought year is perhaps not representative of the trend of malaria in this country In Tennessee where county wide surveys were made during 1930 the incidence was found to be very much lower than in 1929 due undoubtedly to the drought An increase in malaria is to be expected in the future in the presence of normal conditions of rainfall

Dr Faust (closing)—I wish to agree with those dis-

SYMPOSIUM ON MALARIA, Part 2*

OBSERVATIONS ON MALARIA INCIDENCE IN SOME UNSANITATED RIVER VILLAGES IN THE REPUBLIC OF PANAMA WITH SPECIAL REFERENCE TO PROPOSED CONSTRUCTION PROJECTS IN THE CANAL ZONE*

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and
W H W KOMP ‡
Ancon, Canal Zone

The methods usually applied in the control of malaria consist in permanent drainage or routine treatment of anopheline mosquito breeding areas screening of living quarters and the hospital and dispensary treatment of malaria for those who seek such medical care Measures in malaria control seldom include the treatment of that vast number of rural people who really form most of the seed bed of malaria and perpetuate the risks of transfer to contacts living under better circumstances Usually people who pass their lives in these rural areas show a comparatively high tolerance to the disease and they are not therefore prone to follow a complete vigorous course of treatment that would in many cases eradicate it We are interested in studying and stimulating control measures directed at this seed bed of malaria It is fully realized that this branch of malaria control is expensive but it should be attacked with the same vigor use of funds and personnel that mosquito control receives The screening or mosquito proofing of quarters mosquito control and efforts toward eradication of the infection in human carriers should proceed together and with equal emphasis if circumstances permit Unfortunately financial circumstances and other conditions frequently make this *ideal impossible*

The Panama Canal Zone in its strictly sanitated area has for years presented excellent evidence of what can be done in malaria control by the use of screened quarters and mosquito breeding control Rural labor units sent outside the sanitated zone for duty also receive unusually good protection if the individual will take full advantage of the opportunities provided. Here however trouble develops Most rural units are well protected during the working period of the week, but they spend the week end too frequently outside protected or sanitated areas It is the rural organization in contact with uncontrolled malaria seed beds that excites interest We have had the good fortune during the past year to assist the Health Office of the Panama Canal in studying the malaria parasite index in rural inhabitants outside the sanitated zone and also to perform monthly blood film surveys on workers engaged in the road building and in the preliminary construction work on the Madden Dam which will be located in the mid basin of the Chagres River

It is morally certain that a large fraction of the labor force to be used in the building of the Madden Dam durin the next few years will not be satisfied to live in the protected camps provided for them since there are too many small rural villages near by in which they can provide themselves with their own quarters and live with their families. We have selected for our present topic of discussion five of these villages They lie just inside the Republic of Panama on the banks of the Chagres River with one exception and this village is a short distance away on the bank of the Gatuncillo River which is a branch of the Chagres Many of the men now engaged in the preliminary work at Madden Dam go home each night in their own little river boats. No doubt these villages will be greatly increased in population during the years in which this project will be developed It takes the men in the remote villages about an hour in their boats to reach their work These villages are populated at present very largely by river folk that have had little contact with the outside world Until recently they had no local medical or sanitary help They depended on river water for all household uses and had no latrines or pit closets Th vast majority of the houses have a *thatched roof cane walls and dirt floor and nearly all* of the houses are quite near the river bank. These people cultivate small farms and most of these are from one to two days river travel upstream from their village This means that they divide their time between their home villages and farm houses this making it extremely difficult to follow a regular schedule of treatment or survey work. Vast potential breeding areas for mosquitoes are all about these locations in the form of grassy river banks river bayous or lagoons and small collateral brooks that run through the villages These five villages provide an excellent unmolested rural river location for the study of malarial problems. We began our observations in these places in cooperation with the Republic of Panama and the

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tion that parasites of bird malaria which in the insect host are difficult to distinguish from the human strain have been carried over in the common culex mosquito *Culex quinquefasciatus* for a period as long as the insect remained alive namely a duration of 183 days.

A word as to the transportation of live mosquitoes This can be managed through ordinary post or by express or as hand baggage or checked baggage by ordinary train travel We have found no difficulty in keeping mosquitoes in prime condition by these various methods, if moisture and low temperature are provided Even in India I have shipped mosquitoes long distances by merely surrounding the netted cage by moistened gauze pads In fact one of my co workers in India has been successful in transporting live mosquitoes from India to London by this means. You may remember that the first mosquitoes were transported from Italy to London in this manner in the historical experiment of Sir Patrick Man on some thirty years ago

During cold weather one can actually send a few mosquitoes in a mailing tube for short distances but I would not recommend this method publicly as there are objections at present to shipping mosquitoes especially by aeroplane over countries not yet free of yellow fever

Relation of Temperature—Many observations tend to confirm the general impression that the gametocyte is less virile than the sporozoite The gamete apparently requires a higher temperature for existence and development which reflects on its origin from the warm blooded host and is possibly a matter of adaptation The sporozoite has a greater range of adaptability surviving temperatures of freezing to as high as 122 F an adaptation to an environment afforded by the cold blooded mosquito host

If a batch of anophelines is placed after biting a suitable person in an atmosphere under 60 F the gametocytes taken with the host's blood either fail to exhibit exflagellation or gametogenesis is otherwise rendered innocuous the sporogonic cycle receiving a decided check On the other hand a batch of mosquitoes may be exposed to temperatures as low as 32 to 38 F if the cyclical development has been encouraged to the sporozoite stage Therefore one must seek an optimum for the existence of the mosquito host and the perpetuation of its parasite

High temperatures 80 F and above having been repeatedly shown to be unfavorable to length of life of the artificially maintained insect our procedure is to keep the infecting mosquito (when not applied to the patient) at temperatures averaging 76 F during the period when sporozoites are developing and following this at temperatures of a well kept cold room of the hospital morgue at 38 to 40 F They are subsequently shipped when required at temperatures of a portable refrigerator maintained at 38 F or below

The potentiality of the mosquito is emphasized when one realizes that a single mosquito may infect a great many persons. It was shown by the British authorities that a single batch of mosquitoes could be used to infect as many as forty persons, and we have shown in some former work that a single mosquito may actually infect eleven persons

The matter of viability and resistance of the sporozoites in the mosquito is engaging our attention at present on account of the possibility of using sporozoites in suspension in various media and thus obviating the difficulty of carrying live mosquitoes from place to place This work has been inaugurated in the South Carolina State Hospital and for the first time we have been successful in producing malaria by inoculating a patient with sporozoites in citrate suspension

Up to the present time we have tried out preservation of sporozoites with a variety of sugars glycerin citrate and ordinary physiological salt solutions and find that the sporozoite however resistant in the mosquito is easily destroyed in vitro when in contact with these reagents It may be pointed out that sporozoites persist in a mosquito long after its death and we have recovered sporozoites from dead mosquitoes fully 48 hours more recently 65 hours after the insect has died Also we have shown that although the mosquito may be killed by heat at a temperature of about 43 to 45 C., the sporozoites on dissection show viability We have observed that to kill the sporozoites it is necessary to apply heat very close to 50 C (122 F)

Two experiments of recent development have not been sufficiently matured for final report but are mentioned in the hope that interest in this direction may be stimulated Twelve patients have been inoculated with sporozoites washed from the infected mosquitoes stomach as well as from the salivary glands

It has been found possible to keep the mosquitoes oocyst infected gut and wash it at intervals during the course of 72 hours while the newly ripened oocysts are discharging the accumulated sporozoites into the sterile mounting medium

It is possible to collect this material after four successive crops of sporozoite discharges

DISCUSSION (*Abstract*)

Dr M A Barber New York N Y—I have had some experience with the transporting of living malarial mosquitoes. Last May we sent some from West Africa to London We put them on a steamer in the hands of the ship's surgeon When the ship arrived at Plymouth they were put in charge of the quarantine officer and he put them in care of the train guard. When they arrived in London they were met by a representative of the Board of Health.

Dr Mayne (closing)—*In malaria therapy* the mosquito inoculation method could be enhanced in value by applying the mosquito to the patient in biting by the interrupted method As you are aware it has been proved that a bite of twenty to thirty seconds is productive of infection and is equal in effectiveness to that of an uninterrupted blood meal of eight to ten minutes

One may thus conserve the sporozoite contents of the salivary lobes and by the mechanism of limited discharge distribute the full crop by applying the mosquito to an unlimited number of patients

SYMPOSIUM ON MALARIA, Part 2*

OBSERVATIONS ON MALARIA INCIDENCE IN SOME UNSANITATED RIVER VILLAGES IN THE REPUBLIC OF PANAMA WITH SPECIAL REFERENCE TO PROPOSED CONSTRUCTION PROJECTS IN THE CANAL ZONE*

By H C CLARK M D,†
and
W H W KOMP ‡
Ancon, Canal Zone

The methods usually applied in the control of malaria consist in permanent drainage or routine treatment of anopheline mosquito breeding areas screening of living quarters and the hospital and dispensary treatment of malaria for those who seek such medical care Measures in malaria control seldom include the treatment of that vast number of rural people who really form most of the seed bed of malaria and perpetuate the risks of transfer to contacts living under better circumstances Usually people who pass their lives in these rural areas show a comparatively high tolerance to the disease and they are not therefore prone to follow a complete vigorous course of treatment that would in many cases eradicate it We are interested in studying and stimulating control measures directed at this seed bed of malaria It is fully realized that this branch of malaria control is expensive but it should be attacked with the same vigor use of funds and personnel that mosquito control receives The screening or mosquito proofing of quarters mosquito control and efforts toward eradication of the infection in human carriers should proceed together and with equal emphasis if circumstances permit Unfortunately financial circumstances and other conditions frequently make this ideal impossible

The Panama Canal Zone in its strictly sanitated area has for years presented excellent evidence of what can be done in malaria control by the use of screened quarters and mosquito breeding control Rural labor units sent outside the sanitated zone for duty also receive unusually good protection if the individual will take full advantage of the opportunities provided. Here however trouble develops Most rural units are well protected during the working period of the week, but they spend the week end too frequently outside protected or sanitated areas. It is the rural organization in contact with uncontrolled malaria seed beds that excites interest We have had the good fortune during the past year to assist the Health Office of the Panama Canal in studying the malaria parasite index in rural inhabitants outside the sanitated zone and also to perform monthly blood film surveys on workers engaged in the road building and in the preliminary construction work on the Madden Dam which will be located in the mid basin of the Chagres River

It is morally certain that a large fraction of the labor force to be used in the building of the Madden Dam during the next few years will not be satisfied to live in the protected camps provided for them since there are too many small rural villages near by in which they can provide themselves with their own quarters and live with their families. We have selected for our present topic of discussion five of these villages They lie just inside the Republic of Panama on the banks of the Chagres River with one exception and this village is a short distance away on the bank of the Gatuncillo River which is a branch of the Chagres Many of the men now engaged in the preliminary work at Madden Dam go home each night in their own little river boats. No doubt these villages will be greatly increased in population during the years in which this project will be developed It takes the men in the remote villages about an hour in their boats to reach their work These villages are populated at present very largely by river folk that have had little contact with the outside world Until recently they had no local medical or sanitary help They depended on river water for all household uses and had no latrines or pit closets The vast majority of the houses have a thatched roof cane walls and dirt floor and nearly all of the houses are quite near the river bank These people cultivate small farms and most of these are from one to two days river travel upstream from their village This means that they divide their time between their home villages and farm houses thus making it extremely difficult to follow a regular schedule of treatment or survey work Vast potential breeding areas for mosquitoes are all about these locations in the form of grassy river banks river bayous or lagoons and small collateral brooks that run through the villages These five villages provide an excellent unmolested rural river location for the study of malarial problems. We began our observations in these places in cooperation with the Republic of Panama and the

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Panama Canal so that our work might have some practical bearing as well as laboratory value We hoped that one year's experience would direct us in formulating future plans in these locations in contact with the development of the Madden Dam

We had expected during the year to pursue routine observations on the following points

(1) Mosquito density in quarters

(2) Mosquito breeding areas

(3) Primary survey for the malaria parasite index spleen index and hemoglobin index

(4) Provide the villages with a community nurse free quinine and voluntary administration of the drug

(5) Monthly surveys for the malaria parasite index for a year under voluntary quinine administration

(6) Record the character of cooperation of the inhabitants

(7) Study the babies with regard to the age at which they acquired malaria and thus provide some information on exposure to new infection in such places

(8) Note the rate of gamete carriers in relation to gamete carriers that might be considered good mosquito infectors

(9) Note the number of heavy infections found that are of the usual hospital intensity type

(10) Note house and individual incidence during the year

A detailed monthly report on mosquitoes caught in quarters and in traps and the routine searches of potential breeding areas for mosquito larvae cannot be given for the year due to conditions and interruptions we could not control However the anopheline flights and catches in quarters during the first six months of this period were not so extensive as we anticipated and not so extensive as the low inhabited sea coast plains exhibit

Sampling of the huge river bayous revealed very little evidence of anopheline mosquito breeding [illegible] though the small brooks and pools behind the villages show such breeding except in the dry season months

Primary Survey of Inhabitants—The initial examinations were conducted in two villages (New San Juan and Gatuncillo) in December 1929 while Santa Rosa Guayabalito and Las Guacas were examined in September 1929 We examined once by the thick film method 260 children (15 years old or less) and found 147 of them positive or a rate of 56 6 per cent 339 adults revealed 126 cases or a rate of 37 2 per cent The total parasite rate was 45 6 per cent and the total spleen rate was 21 8 per cent

These people are strongly negroid in type and do not show the degree of splenic enlargement commonly found Only sixteen of them had spleens that extended more than two fingers below the costal margin Of the 273 individuals positive for malaria parasite only 48 or 17 5 per cent were of the hospital intensity type There were 160 cases of *P falciparum* infections and 51 of them showed crescents but only 8 of them in such abundance that they would be considered good mosquito infectors

The hemoglobin index was taken by the Tallquist method on 508 of the inhabitants and 153 (30 1 per cent) ranged between 30 and [illegible] per cent while the remainder 355 (69 9 per cent) scaled between 70 and 80 per cent

Treatment—Compulsory quinine treatment was in effect at the Madden Dam screened labor camps and with this as a yard stick we instituted in the contact villages voluntary free quinine treatment under the direction of a community nurse who was given assistance by school teachers in three villages and by the corregidors in the other villages After each survey the list of those positive for malaria was given the nurse and each adult case was supplied with enough of the drug to carry out a ten day course of treatment of [illegible] grains a day while children received a graded dose of the drug according to size for the same period of time Anyone who developed fever between the periods of survey was supplied with quinine and second day visits were made by the nurse [illegible] encourage those with malaria to keep up their treatment During the school period of the year we had the cooperation of the teachers in carrying on the treatment of children Our surveys were conducted once a month starting with September 1930 and ending with August 1931 The results are tabulated below

CONSOLIDATED REPORT ON THE FIVE VILLAGES BY MONTHS

(Adults and Children Combined)

Date	Number Examined	Number Cases Malaria	Malaria Parasite Index	Rainfall inches Alhajuela (Madden Dam)
September 1930	289	47	16 2	12 63
October 1930	339	[illegible]	15 6	10 15
November 1930	290	[illegible]	20 0	3 08
December 1930	300	[illegible]	27 0	0 88
January 1931	433	[illegible]	21 5	0 74
February 1931	398	[illegible]	0 6	0 13
March 1931	513	80	15 6	2 35
April 1931	529	112	21 1	2 19
May 1931	463	123	26 5	11 08
June 1931	398	106	26 6	13 72
July 1931	425	[illegible]	20 2	12 81
August 1931	420	116	27 8	9 06
Twelve months totals	4797	1037	21 6	78.32

The mean temperature record for the Pacific Section of the Canal Zone for the year 1930 was 87 8 degrees, and for the Atlantic Section 86 3 degrees Since the Chagres River locations are midway between the two oceans and are only fifteen feet above the surface of Gatun Lake it may be taken for granted that the temperature is about the same as those recorded for the Balboa Heights and Cristobal stations Note the wide variation in the number presenting themselves for examination at each survey School period planting and harvesting time have something to do with these variations

The parasite index for each month does not parallel the monthly rainfall since it is fairly steady throughout the year

The following tables will compare the parasite rates

NEW SAN JUAN

(On banks of the Gatuncillo)

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment	[illegible]	52	59.1
Average of 12 surveys of children. Voluntary treatment	71	16	22.5
Primary survey adults. No treatment	141	43	30.5
Average of 12 surveys of adults. Voluntary treatment	61	8	13.1

GATUNCILLO

(At the junction of the Chagres and Gatuncillo Rivers)

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment	34	14	41.1
Average of 12 surveys of children. Voluntary treatment	28	9	32.1
Primary survey adults. No treatment	26	4	15.3
Average of 12 surveys of adults. Voluntary treatment	24	5	1 0

GUAYABALITO

(On the banks of the Chagres)

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment	52	32	55.1
Average of 12 surveys of children. Voluntary treatment	49	13	26.5
Primary survey adults. No treatment	58	27	46.5
Average of 12 surveys adults. Voluntary treatment	32	7	21.9

SANTA ROSA

(On the banks of the Chagres)

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment	[illegible]	38	60.3
Average of 12 surveys of children. Voluntary treatment	61	16	26.2
Primary survey adults. No treatment	[illegible]	39	46.4
Average of 12 surveys of adults. Voluntary treatment	36	5	13.9

LAS GUACAS

(On the bank of the Chagres. Almost surrounded by water)

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment	23	11	47.8
Average of 12 surveys of children. Voluntary treatment	17	4	23.5
Primary survey of adults. No treatment	30	[illegible]	43.3
Average of 12 surveys adults. Voluntary treatment	20	3	15.0

of the initial surveys when no treatment was available with the average monthly parasite rate during the year when voluntary free quinine treatment was in effect

CONSOLIDATED VILLAGES

Primary Surveys. No treatment in use

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Children	260	147	56.5
Adults	339	126	37.2
Total	599	273	45.6

CONSOLIDATED VILLAGES

Average of 12 Monthly Surveys. Treatment in use

Children or Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Children	226	58	25.6
Adults	173	28	16.2
Total	399	86	21.6

The following table shows the effect of screened camp quarters and the compulsory use of quinine for those positive for malaria. These labor units are located in the same general area as the villages

RURAL LABOR UNITS

The Panama Canal

Average of 16 Thatcher Highway Surveys / Average of 14 Madden Dam Surveys	Number Examined	Number Positive Malaria	The Malaria Rate
Thatcher Highway forces	244	9	3.7
Madden Dam [illegible] forces	272	14	5.1
Total	516	23	4.4

SPECIES MALARIA PARASITES

(For the 12 Village Surveys)

Date	P. falciparum	P. vivax	P. malariae	Mixed	Total
September 1930	18	23	2	4	47
October 1930	25	23	5	[illegible]	[illegible]
November 1930	37	13	8	0	[illegible]
December 1930	36	[illegible]	2	1	81
January 1931	[illegible]	41	9	1	93
February 1931	64	17	1	0	32
March 1931	54	21	3	2	80
April 1931	80	[illegible]	11	3	112
May 1931	97	20	4	2	123
June 1931	83	[illegible]	5	0	106
July 1931	73	8	5	0	[illegible]
August 1931	92	[illegible]	4	0	116
Total	701	264	59	13	1037

This shows the distribution of species as follows:

P. falciparum	67.6 per cent
P. vivax	25.4 per cent
P. malariae	5.7 per cent
Mixed	1.2 per cent

We have established the gamete rate on the species *P. falciparum* since the gamete of this species is more easily and surely detected by the various technicians and it is our most common form of malaria.

INCIDENCE OF P. FALCIPARUM CRESCENTS

Monthly Surveys

Date	P. falciparum Cases	Number of Crescent Carriers	Monthly Rate of Crescent Carriers	Good Infector Types of Crescent Carriers
September 1930	[illegible]	10	45.4	5
October 1930	[illegible]	10	40.0	6
November 1930	37	4	10.8	3
December 1930	37	2	5.4	2
January 1931	43	6	13.9	4
February 1931	64	14	21.8	9
March 1931	[illegible]	23	41.0	9
April 1931	83	24	28.9	7
May 1931	99	21	21.2	6
June 1931	[illegible]	14	16.8	4
July 1931	73	14	19.1	2
August 1931	92	22	23.9	8
Total	714	164	22.9	65 (39.6%)
Primary survey	160	51	31.8	8 (15.7%)

INCIDENCE OF MALARIAL INFECTIONS OF HOSPITAL INTENSITY TYPE

Date	Las Guacas	Santa Rosa	Guayabalito	Gatuncillo	New San Juan	Totals
September 1930	1	4	0	2	1	8
October 1930	0	6	0	4	4	[illegible]
November 1930	0	3	4	3	3	[illegible]
December 1930	0	1	0	1	1	3
January 1931	2	3	3	2	6	[illegible]
February 1931	1	[illegible]	2	0	5	8
March 1931	[illegible]	5	1	5	5	16
April 1931	0	5	7	5	9	26
May 1931	0	7	5	1	5	18
June 1931	2	6	3	2	8	21
July 1931	1	4	0	2	6	[illegible]
August 1931	1	3	6	3	4	17
Totals	8	47	31	30	57	173

These cases were not sent to any hospitals or dispensaries for treatment but they represent the intensity of infection that usually does require hospitalization. These people have a decided negroid blend and their tolerance is high. It very seldom happens that anyone dies as a result of a malarial attack in these villages but they are below par for any sustained daily physical effort and form a seed bed for the propagation of the disease.

The twelve monthly blood film surveys revealed 1,037 persons that were positive for malaria parasites and 173 of them or 16.6 per cent were of the type usually requiring treatment in a hospital. The initial survey of the five villages yielded 273 persons showing parasites, 48 of them with severe infections or 17.5 per cent.

It is impossible for us to know how many of these cases of malaria found in field surveys are newly acquired infections and how many represent relapse. We certainly feel that relapse forms the bulk of each village index. In order to gain a little light on the question of exposure in such locations and the period of time the average individual might live in such surroundings before acquiring malaria we have made it a rule to examine all babies. We have collected our records on the babies examined in these five villages and in several other locations similar to them. The results are tabulated below.

BABY SURVEY

Rural Villages and Farm Houses

Ages	Number Examined	Number Positive For Malaria
1 month or less	6	0
1 to 2 months	7	0
2 to 3 months	13	3
3 to 4 months	16	3
4 to 5 months	7	0
5 to 6 months	11	5
6 to 7 months	17	5
7 to 8 months	16	2
8 to 9 months	9	6
9 to 10 months	11	0
10 to 11 months	12	6
11 to 12 months	95	[illegible]
Total	220	50

During the first six months of life the parasite index was 18.3 per cent and in the second six months it was 24.4 per cent. No parasites were found in the thirteen babies that were two months or less of age.

The 50 out of 220 babies gives a parasite rate of 22.7 per cent and that is about what the average consolidated village rate is for total inhabitants.

SPECIES OF PARASITES FOUND IN THE BABIES

Species of Parasite	Number of Cases	Species Incidence	Species Incidence in Total Inhabitants of the Five Villages
P. falciparum	33	66.0	67.6
P. vivax	15	30.0	25.4
P. malariae	1	2.0	5.7
Mixed infection	1	2.0	1.2

MALARIA RATES IN PERMANENT INHABITANTS

During the course of the monthly surveys many individuals were examined only once, being casuals in the town, friends or relatives of the inhabitants. These casuals swelled the total numbers of those surveyed and contributed their portion to the malaria rate. To offset any influence they may have had and to determine

the effect of house location and other factors on family malaria another compilation of the individuals and rates in the surveys was made using as a base an official census made in May 1931 during a hookworm campaign In this census all houses with their occupants were enumerated in each town From these records it was possible to discover the place of residence and the relationships of the inhabitants The result for the five towns show the difficulties in the way of any treatment campaign which may be instituted in the future In all 772 persons listed in the census were examined at least once during the course of the surveys Of these 417 or 54 0 per cent showed the presence of malaria That this is not the true incidence of the disease is shown by the percentage positive found in those examined 8 to 13 times There were 181 individuals so examined of whom 153 or 84 5 per cent were positive Very few persons were examined 12 successive time at monthly intervals 32 so examined showed 27 positive or 84 4 per cent Of those 13 persons examined in the original survey and at every successive survey 12 or 92 3 per cent were positive No doubt this per cent could be increased by greater frequency or by longer periods of examination That the rate of 54 0 per cent found in the surveys was too low is shown by the fact that over two thirds of those surveyed (68 0 per cent) were examined 6 times or less Fifty per cent were examined 4 times or less An interesting relation between number of persons and of malaria cases in a house is present Thus in Guayabalito only a quarter of those who live by themselves have malaria while of those living in dwellings housing seven persons 85 7 per cent have malaria This is no doubt in part explained by the fact that those living alone are older persons while the large families contain many children whose rate is always high It is impossible to give the exact average age of those living alone to compare with the age of the adults living with large families but five of six adults who lived with large families had malaria while only two of eight living alone contracted the disease An important factor bearing on this phase is the increased attraction for Anopheles of a house full of small children as against the small attraction of a single inhabitant

GUAYABALITO

R lat I mb f perso m lar [illegible] se b h se d mb f ses f

N H use	1	2	3	4	5	6	7
Number of houses	8	[illegible]	9	7	8	2	3
Possible cases of malaria	8	12	27	28	40	[illegible]	21
N t lly positive	2	6	[illegible]	16	29	2	18
Percentage having malaria	25	50	66 6	57	72 5	16 6	85 7

LAS GUACAS

N of houses	8	7	6	2	3	1
Possible malar	8	14	[illegible]	8	[illegible]	6
Actual malar	3	6	10	6	7	5
Percentage having malaria	37 5	43 0	55 5	75 0	46 6	83.3

Because of incomplete data it was impossible to tabulate similar information for the remaining three towns

SUMMARY

(1) Five primitive river bank villages located in the mid basin of the Chagres have been observed for one year Thick blood film surveys were conducted once each month Those found positive were placed on voluntary treatment with free quinine and others who desired quinine between surveys were supplied The average of 12 monthly surveys shows a reduction of the parasite rate to one half its primary incidence

(2) The cooperation of these people unaccustomed to public health discipline was far better than we could have expected although it was by no means all that is required to gain the full benefit of field treatment against the malaria seed bed Mass treatment under thorough discipline is necessary to bring the parasite index anywhere near the rate of the adults in the screened labor camps of the Panama Canal a short distance up the river from the villages

(3) Anopheline mosquito density in spite of the vast potential breeding areas near by is not so great as in the inhabited sea coast plains The Madden Dam will be completed in a few years and only a small operating personnel will live at the site Extensive permanent anti mosquito operations about these contact river villages are therefore not indicated Screening or mosquito proofing the native house as a general measure will not meet with the approval of these river folk It therefore becomes an area of great interest if thorough mass treatment can be inaugurated during the coming year with quinine and plasmochin

(4) Examination of babies during the year showed no positives until the third month of life but the general rate up to 12 months of age was about the same as the combined rates for the villages Successive monthly surveys for a year on the other inhabitants indicate that nearly all of them reveal parasites at some time during the year New infections therefore appear to play a less important role in maintaining the village index than relapse

(5) Carriers harboring sufficient gametocytes to be good infectors for the mosquito are rare The incidence of this type of carrier among those who revealed estivo autumnal crescents was 15 7 per cent before voluntary quinine started and during the period of treatment it was 39 6 per cent

(6) Severe infections were not very infrequent but none of them desired to have hospital treatment and their stay in quarters was very brief

(7) The monthly incidence of malaria as revealed by the blood film survey showed almost no tendency to follow the curve in rainfall

(8) The house or family incidence of malaria appears to depend more on the number and character of the people in a given house than upon the character and location of the house A large family will form a greater attraction for the Anopheles mosquito than a single individual in a house

Seven hundred and seventy two permanent inhabitants of the five river villages examined at least once each gave a rate of 54.0 per cent. One hundred and eighty one permanent inhabitants examined at least eight times gave a rate of 92.3 per cent showing that presumably the entire population at one time or another during its lifetime becomes infected with malaria.

THERAPY OF CHRONIC MALARIAL SPLENOMEGALY*

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The phenomenon of contraction of the spleen following the administration of suprarenalin in addition to having diagnostic application has also been the subject of therapeutic tests conducted by Peserico (1920), Izar (1929) and Starnotti (1930). The results obtained by these workers have, however, not been wholly satisfactory.

Peserico, using subcutaneous injections of 0.5 milligram of suprarenalin repeated every four hours for about fifteen days, succeeded in one case only in bringing about a reduction in the swelling of the spleen and in curing the anemia. The case was one of pernicious splenomegaly during pregnancy. Starnotti, employing daily subcutaneous injections of adrenalin in various kinds of splenomegaly, found that after a certain number of contractions had been produced the spleen no longer responded to the stimuli. In this connection we might recall the practice of treating malarial infections by a combination of suprarenalin and quinine for the purpose of setting into circulation the parasites lodged in the spleen.

With the technic heretofore in use, the amount of suprarenalin administered is relatively large and it must be considered that only a fraction of the drug so given is useful for the end in view. If the purpose to be achieved cannot be accomplished in the designated way, the organ should be approached more directly, that is, by intravenous inoculations. The direct method is in accordance with the practice already followed in our clinic for other conditions, as for example the intratracheal injection of gold preparations in pulmonary tuberculosis,[4] the use of suprarenalin in hemoptyses (Giuffrida) and of emetin rectally in amebic hepatitis (Pappalardo).

The field of splenomegaly is a large one, diverse in etiology, anatomical conditions and terminology. We have therefore limited our investigations solely to the enlargement of the spleen found in malaria.

A series of patients with chronic malarial splenomegaly, in whom the splenomegaly had resisted the usual quinine arsenical treatments, were injected intravenously during the afebrile stage with minimal doses of suprarenalin. The patients remained free from circulatory and renal disturbances. Of particular importance is the fact that the doses of suprarenalin used by us were small, beginning with 0.01 milligram, gradually increasing to 0.1 and finally reaching a total of 2, 3, and rarely 4 milligrams. By the subcutaneous method the equivalent dose of the drug (in the proportion of 1:100 usually adopted by pharmacologists) would amount to the large quantity of 200, 300, or 400 milligrams.

The action of the drug may be said to be immediate, the resulting symptoms being pallor, headache, tremors, sometimes psychic and motor excitation, and palpitation. The injections as a rule are given daily or on alternative days if the patient's general reaction is intense, the dosage being increased by 0.01 milligram until the total quantity as above indicated is reached. The final dose of 0.1 milligram (seldom 0.2) is repeated about twenty or thirty times until the swelling of the spleen disappears or becomes negligible, which generally happens in about two months. We again desire to draw attention to the fact that the patients had no febrile attacks during treatment and in the course of the administrations were not subjected to any other form of treatment.

The rhythm and mode of spleen regression varied from case to case. In general it may be said that every contraction was followed by a limited expansion, and the reduction was greater in proportion as the doses of the drug were increased.

The following cases responded in the shortest periods of time:

Case 1.—I. C., age 25, had had malaria for about seven years, during which time he had always been subject to attacks of fever in the summer, which were treated with quinine. The last attack occurred a month before admission to the clinic. He had already been afebrile for 15 days and this state was maintained during the entire stay in the hospital. The spleen was found to be large, firm, reaching to the iliac and anteriorly to the xiphoid umbilical lines.

Thirty two suprarenalin injections were given in a period of 45 days (total 3 milligrams). The spleen wholly regained its physiological limits.

BLOOD COUNT

	On Admission	On Departure
Erythrocytes	2,000,000	4,500,000
Leucocytes	3,000	5,900
Hemoglobin (Sahli)	70	90

Case 2.—P. R., age 35, attacked by malaria three years previously, has had no febrile attacks for a year; latterly has noticed pallor, weakness, marked emaciation and swelling of the lower extremities, for which admission to the clinic was sought.

The subject was noticeably ill, having an earthy yellow color, swelling of the lower extremities, a firm

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spleen reaching from the costal margin to beyond the umbilical line and medially to the parasternal line

After a short period of observation he was subjected to suprarenalin treatment. With 40 injections (total 3.5 milligrams) subdivided over a period of 60 days a complete reduction of the marked splenic swelling was effected.

o c UN

	On Admission	On Departure
Erythrocytes	625 000	4 000 000
Leucocytes	3 000	4 500
Hemoglobin (Sahli)	40	80

Case 3.—C. F., age 35, had contracted malaria about four years previously. The subject, deficient mentally, was unable to give exact information as to the course of the disease. He had received quinine treatments.

The impression was apathetic, color pallid, state of nutrition fair, spleen hard, enlarged and palpable below to about four finger's breadth from the costal margin and anteriorly at the perpendicular bisecting line of the clavicle.

After 40 injections (total 3.5 milligrams) given during the course of two months, the treatment was found not to have brought about any reduction of the size of the viscus.

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	On Admission	On Departure
Erythrocytes	1 500 000	2 000 000
Leucocytes	3 600	4 000
Hemoglobin (Sahli)	80	80

Case 4.—In G. L., age 26, the disease manifested itself fourteen years ago. Every year during the estivo-autumnal season he has been subject to relapses, treated with quinine, to which they have yielded. Before entering the clinic he had been afebrile for some time.

His nutrition was poor. A large spleen reached below the umbilicus transversely, medially to the perpendicular bisecting line of the clavicle.

After the usual period of observation 30 injections (total 2.5 milligrams) were given in a period of 38 days and the spleen was reduced to about two thirds of its former size.

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	On Admission	On Departure
Erythrocytes	1 700 000	3 000 000
Leucocytes	5 000	5 000
Hemoglobin (Sahli)	0	80

Case 5.—G. R., age 42, had the first attack of malaria about twelve years previously and several relapses thereafter. He was treated with quinine and arsenical preparations. He had been afebrile for about seven months. During this time he was conscious of fatigue, had an earthy yellow color, for which reasons he applied for treatment to the clinic.

He was pallid in color, the sclerotic coat of the eye was somewhat jaundiced, the spleen hard, reaching about four finger breadths beyond the costal margin and palpable anteriorly at the parasternal line.

In this case the treatment could not be completed, the patient being removed from the clinic for personal reasons. Nevertheless the spleen was reduced more than half after 20 injections (total 1.5 milligrams).

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	On Admission	On Departure
Erythrocytes	900 000	2 000 000
Leucocytes	1 600	3 000
Hemoglobin (Sahli)	50	0

Case 6.—T. P., age 36, contracted malaria in Albania sixteen years ago. He had recurrences every summer treated with quinine. For three years he had noticed a progressive deterioration with pains in the left hypochondrium, fatigue and pallor.

The spleen was firm, reached the umbilicus transversely and medially the perpendicular bisecting line of the clavicle.

In the space of two months he received 40 injections (total 3.5 milligrams). The spleen, after being reduced by about two thirds of its size, remained stationary.

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	On Admission	On Departure
Erythrocytes	4 200 000	4 300 000
Leucocytes	4 000	4 000
Hemoglobin (Sahli)	0	70

An analysis of the results obtained in the various cases shows that the most successful outcome with disappearance of a marked splenomegaly was achieved in *Cases 1* and *2*, which were of relatively recent standing (seven and three years respectively), while in three of the remaining cases a variable though definite reduction of the spleen was effected. One case proved refractory to treatment. Because of the mental condition of the patient, the date of beginning of the illness could not be ascertained.

In general it appears that as much reduction of the *spleen was obtained as was possible with the degree of* permanent sclerosis present in the viscus.

We have observed that the intravenous suprarenalin treatment (without the aid of any auxiliary treatment) in reducing the splenomegaly has led also to a parallel improvement of the blood picture. In other words the suprarenalin treatment has had a beneficent effect upon the anemia of malaria. The fact that this improvement took place in direct correlation with modification of the size of the spleen, showing a maximum effect when the reduction was complete and no effect when there was no reduction, indicates that its mode of action may be the suppression of factors inducing anemia. Such factors may be either a blood destroying agent or an inhibiting component of medullary hemopoiesis or a latent afebrile hemolysis of parasitic origin.

As has already been stated, the *treatment requires* minimal doses of suprarenalin from 2 to 4 milligrams. When one reflects that only a fraction of the drug is able to act on the spleen, the relationship between the minimal quantity used and the complete disappearance in favorable cases, of the extensive splenic swelling, becomes still more impressive.

The present research begun over a year ago is being continued at our clinic as opportunity offers. In view of the practical importance of the subject we present at this time this limited number of selected cases of malarial *splenomegaly treated with suprarenalin in the* hope that confirmation of our results may be achieved with a larger series.

SUMMARY

The authors have treated with minimal doses of suprarenalin administered intravenously a series of cases

of malarial splenomegaly. They have obtained total or partial reduction in the size of the spleen paralleled by an improvement in the blood picture.

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MALARIA CONTROL WORK IN WEST AFRICA*

By M. A. Barber, Ph.D.,†
New York, N. Y.

In this paper I deal only with the coast region of West Africa and particularly with Nigeria, Liberia and Sierra Leone, localities of which I have some first hand knowledge.

The portion of the coast region situated between the Senegal and Congo Rivers is perhaps the most malarious in the world. Antimalaria measures meet there with special difficulties: the negro populations are little inclined to health measures of any kind; the temperature is everywhere tropical; the rainfall almost continuous in some localities, as Cape Palmas, is in all places sufficient to provide mosquito breeding waters over long periods of the year. Anopheles are abundant, particularly the species *costalis* and *funestus*, both of which are domestic in their habits and very susceptible to malaria.

Of these species *costalis* is the most formidable. It is very adaptive as regards breeding places, developing in the sun or in the shade, in fresh or brackish water, in temporary rain puddles or in huge lakes and swamps. It may, under favorable conditions, develop from egg to adult in seven days. It bites freely during the first day of adult life and prefers man for its blood supply. In some cases nine days suffice for the maturation of malignant tertian sporozoites in the mosquito stomach and for their appearance in the salivary glands. Among about 15,000 dissections of *costalis* collected in native houses of Southern Nigeria we found an average sporozoite rate of over 6.5 per cent.

In addition to *costalis* and *funestus* there are at least five other anopheline species found infected in nature or incriminated in the laboratory; of these *har greavesi* and *nili* at least are of sanitary importance.

As the result of these conditions we have an African population practically saturated with malaria. The blood parasite rate of younger school children is usually about 90 per cent. We found a parasite rate of 45 per cent among infants three to four months old in a city little varying from the average as regards the degree of malaria danger. Probably few children escape infection during the first year of life. On a plantation in Liberia we found an adult parasite rate of about 80 per cent.

The difficulties of applying antimalaria measures in such a region are readily appreciated. For many years, possibly for many generations to come, we cannot expect to cope with malaria among Africans over any wide area of the country. In certain smaller areas where white control is more effective and where natural conditions favor, the outlook is more promising. These areas are principally cities, which in West Africa enjoy little or no immunity from malaria by virtue of density of population alone. In some cities effective malaria control work has already been done. I mention in particular Lagos, Nigeria, and Freetown, Sierra Leone, localities in which I have assisted in surveys of the human and mosquito populations.

In Lagos the measures employed by the local sanitary authorities have been chiefly drainage, filling and larvicides, the last consisting of oil and Paris green; in Freetown, chiefly drainage and larvicides, the drainage including the training and canalization of streams flowing through the city. Lagos has the natural advantages of a pervious soil and the protection of a lagoon separating by half a mile much of the city from large breeding places. Freetown is situated on a steep hill side where natural drainage is good. Both cities have well organized sanitary departments.

These measures have resulted in a diminution of Anopheles and of the mosquito nuisance in general. I spent two weeks in an unscreened hotel in Freetown without noting a single mosquito in my room. This was at the end of the dry season. A few weeks later I might have been less fortunate. The malaria danger has certainly been reduced. Anopheles are comparatively few in native houses in both cities. Infected *costalis*, however, are still present and the blood parasite rate of children, even of young infants, is still very high. In both localities *costalis* continues to breed in small collections of water, and in Lagos we have good evidence that this species comes in from neighboring coastal swamps situated a half a mile or so across the lagoon. But something definite has been accomplished in the face of great difficulties and the results in both cities encourage further efforts.

During the dry season of 1930 two of us tested the efficiency of larvicides alone in an area surrounding the station of the Rockefeller Foundation for the study of yellow fever. This station, The Yellow Fever Compound, is situated in Yaba, some seven miles from Lagos. By means of oil and Paris green we effectually controlled the breeding of Anopheles in an area of one half mile radius and extended our treatment about one mile to windward. Outside of the half mile radius are situated some large wooded swamps, little if at all productive of *costalis*. The amount of production of this species within a mile radius of the station was probably negligible.

As a test of the efficiency of our work we took the numbers and rate of infection of *costalis* collected in

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†International Health Division, The Rockefeller Foundation.

certain native hou es in the station The experiment was continued over a period of about three months We found that Paris green had to be applied every five days and oil every eight days because of the rapid development of *costalis* in that warm climate and sea son

Our results were hardly brilliant The numbers of *costalis* diminished it is true but remained as great as during the dry ea on of the following year when no larvicidal work was done The sporozoite rate remained at or above the yearly average The malaria danger then was not materially reduced It seemed likely that *costalis* were coming in from a large untreated coastal swamp situated about a mile from the station The appearance in collections at Yaba of a peculiar type of this species would strengthen this supposition a type commonly if not exclusively bred in coastal swamps in this region It seems then that malaria control work in West Africa must take into account a wide dispers on range of *costalis* Some taining ex periments which we did in Liberia indicate that this species w ll range at least half a mile even where long flights are not made necessary by a lack of con venient blood supply or of places to lay eggs

We were materially aided in our control work by the dry season which did away with most of the breed ing except in small ponds During the rainy season many acres of water formed within the half mile radius veritable lakes and innumerable puddles all productive of anopheline larvae

On the whole the function of larvicides in West Africa would seem to be that of adjuvants to drainage and f llin We found little encouragement for extended larvicidal campaigns With the means at present at our disposal the most hope lies in the protect on of lim ted areas and that by the abolition of breeding waters.

I have thus far discussed only antilarval activities I w ll mention briefly some other antimalaria meas ures

Quinine as a preventive of malaria is widely used in We t Africa chiefly in the form of five grain daily doses It is generally recognized by phys cians there th t this drug is not a true prophylactic. It does not destroy sporozo tes But the opin on is general that these small da ly doses prevent more serious mani festations of malaria particularly blackwater fever This opinion however is not universal one can find physicians in Africa who do not recommend this pre ventive treatment but defer medication until symp toms of malaria appear The use of plasmochin as a prophylactic is yet to be tested on a large scale there

Screening is not likely to become general in West Africa Few white people except Americans use it ex tensively and it will be many years before Africans employ this measure on any effective scale It is a most valuable antimalaria measure in Africa or else where to tho e who will use it

Education.—African children take to education as a duck to water and health education is likely to prove of much value

Domestic animals are rarely housed and consist mainly of goats pigs and chickens Human beings are the preferred ho ts of Anopheles a fact proved by direct observation and by numerous precipitin tests of the blood meal of *costalis* and other species.

Whatever measures are applied in this region pec tacular results are not to be expected The campaign will be a long one at b st But something definite has been accomplished and the future promises more

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DISCUSSION (*Abstract*)

Dr Henry Hanson Jacksonville Fla—I was in West Africa from November 1925 until May 1927 During the first part of my stay I devoted very little time to the study of the control of malaria. My official as s gnment was a study of endemicity of yellow fever in the Ibadan area

Dr Barber s paper is a most interesting and val uable presentation of what appeared to be one of the greatest health hazards in Nigeria The question of quinine control merits some discussion The British as well as most of the Europeans who did their tours whether as officials or traders appeared to be firm be lievers in the efficacy of the daily dose of five grains of quin ne taken either at noon or with the evening meal Aboard the ship on which I went out I noted that the old timers began taking quinine about the same time that they began wearing their sun helmets and this appeared to be on approaching Freetown in Sierra Leone This practice was continued until on the return journey they were approaching the European port I began taking quinine immediately after reach ing Lagos (November 1925) and continued quite regu larly until about June 1926 when I became careless to some extent on account of being in a reg on where the *Anopheles costalis* did not appear abundant About the beginning of the fourth week of June I did not feel well and about June 26 I went to bed with a fairly severe attack of a falciparum infect on with both r ngs and cresents showing in the blood The colonial medi cal officers appeared to believe in the efficacy of qui nine control Living as we did in un creened houses there was little chance to escape being bitten Many of the British objected to the screens because they ob structed the breeze

There is little one can add to the extensive observa tions reported by Dr Barber I took a small number of smears from young native children ranging in age from four weeks to ten years in which I obtained 80 per cent positives by the thin mear method The very heavy infections in mo t of the smears were notable and in several of these phagocytosis of infected red cell were observed The natives did not appear to take any precautions against infection and the adults did not appear to have nearly the same de ree of active malaria as the ch ldren The finding of phago cytosis of the infected red cells suggested a process of immunization to account for the lessened amount of malaria among the adults. How extensive the disease is can only be judged by studies like those presented by Dr Barber since statistics either of mortality or morbid ty are almost totally lacking The country is too extensive and the wh te population of about five thousand among eighteen million blacks is too small to

cope with the enormous sanitary problem of Nigeria. Potentially the country is rich and the British Colonial as fine a type of man as one ever meets is doing as much as could be expected under the circumstances. The mosquito bar, mosquito boots and the daily dose of quinine seemed to be the main instruments of control when I was in West Africa and such precautions were limited to the foreign whites.

MALARIA CONTROL AND ANOPHELES CONTROL MEASURES OF THE PAST AND FUTURE*

By J. A. LePrince†
Memphis, Tenn.

It is very easy for most of us to forget that our first means of combating malaria fever was devised by the natives of South America long before the days of Columbus. Also it is not generally known that America's malaria field workers learned at Panama from the Panamaians that the bark of certain trees can be advantageously used as efficient anopheline larvicides. So far as treatment of malaria is concerned we of to-day have not yet any satisfactory substitute for that which originated in Peru.

In colonial days in Georgia a strong effort was made to eliminate malaria in Savannah by legislation by prohibiting the culture of rice near the town and paying the land owners for loss of potential profits.

In the other colonies we built large numbers of small constant level mill ponds and thus caused more new cases of malaria than were cured by the use of Peruvian bark.

It is stated that the colonists used other remedies than quinine for malaria attacks, but we have no record as to whether any of them were effective.

The war of 1860 to 1865 was the indirect cause of widespread distribution of malaria all over our country, and especially so in the Northern states where thousands of new carriers settled.

The effective start of Anopheles control and therefore of malaria control in America was originated by Dr. L. O. Howard, our Honorary Chairman, before any of us knew that malaria was a mosquito borne disease. In his book "Mosquitoes," published in 1901, he states:

> In 1867 the writer used kerosene in a watering trough at Ithaca, N. Y., and found that mosquito larvae were killed by it, and in 1892 I conducted an experiment upon a larger scale in the Catskill Mountains, indicating the quantity of kerosene necessary for a given water surface and showing that adult mosquitoes were captured by a kerosene film, etc., etc.

He distinctly pointed out that oil had been previously used in London in 1812.

This gave us a means of mosquito control that is yet the basis of most American mosquito control activities.

Also when Dr. Howard published his book in 1901 he referred to the use of the electric current as a means of destroying adult Anopheles. On page 15 we find the following:

> Recently Mr. A. DeP. Weaver, an electrical engineer of Jackson, Mississippi, wrote me that while engaged in some experiments in harmonic telegraphy, in which a musical note of a certain pitch was produced by electric means, he was amazed to find that when the note was raised to a certain number of vibrations per second all mosquitoes not only in the room where the apparatus was, but also from other parts and from outside, would congregate near the apparatus and would be precipitated from the air with astonishing force, striking their bodies against the apparatus.
>
> He states that he therefore covered a large surface with sticky fly paper and after sounding the note for a few seconds captured all the mosquitoes in the vicinity.
>
> He then devised an apparatus to electrocute them. A section of wire window screen with paint removed was mounted on a board and small pins were driven between the meshes, the heads coming flush with the surface of the screen. All the pins were connected together electrically, the whole forming one electrode of the secondary coil of an induction coil, while the wire screen formed the other electrode.
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> An alternating current of high potential was then passed and when the note was sounded the insects precipitated themselves against the screen and were electrocuted.
>
> Mr. Weaver unfortunately does not state whether males only were captured in this way. His letter was an extremely interesting one and surely his sticky fly paper experiment suggests that further experimentation in this direction would be worth while.

The discoveries of Sir Ronald Ross apparently had very little effect in starting malaria control activities in the United States, although at that time high malaria prevalence was common in large areas of many states.

The Spanish American War was followed by Dr. Gorgas' campaign against yellow fever and a part of the appropriation for that campaign was used by the writer, with Dr. Gorgas' approval, to see what could be done near Havana toward malaria control. Sufficient was learned from this campaign to indicate what could be done at Panama in case it should be decided to build a canal there.

The campaign in Cuba and Panama indicated clearly what might be accomplished in the malarious portions of our country, but no effective action was taken until Dr. H. R. Carter returned from Panama and started malaria investigational studies and control demonstrations in 1913.

One of the first big tasks was to convince and sell to the state health departments the idea that malaria

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†Senior Sanitary Engineer, United States Public Health Service.

control was practical that it should be undertaken and to indicate how it should be developed That task was accomplished

OUR PRESENT METHODS OF CONTROL

The general public of most of our communities including rural communities desires mosquito freedom and proves it to us each year by spending millions of dollars for metallic mosquito screen to protect its homes Many of our county health departments do not fully realize that this public attitude can and should be so developed as to create a stronger public sentiment for applied rural sanitation as well as to eliminate typhoid, other insect borne diseases and malaria

In some counties where there are school districts with very high malaria rates the directors of the full time health units appear to take relatively little interest in malaria control while others take none Some full time health units are doing very good work along this line

It is somewhat astonishing to note to what a limited extent the use of Paris green is being encouraged by full time county health units here while in other countries its use is being extended most rapidly

At our last convention the possibilities of using county prison labor for Anopheles drainage activities was stressed and we are not yet using as much of this labor as is available

Evidently we have much to learn relative to selling to the public the idea of the advisability and wisdom of rural district undertaking malaria control activities The East Texas Chamber of Commerce which includes 71 town and city chambers of commerce has recently been competing with us along this line and achieved results by obtaining a state appropriation of fifty thousand ($50 000) dollars for a period of two years There is no reason why such activity and progress should be confined to one state and it is evidently worth while for health workers to study and learn how to get active support from associations of business interests It is the writer's opinion that a time effort having a value of one hundred thousand ($100 000) dollars could be advantageously used by state and county health departments along this line and that it would rapidly bring practical results that we only hope for at the present time although it has long been and yet is within reach of achievement if gone at in a proper manner

The United States Public Health Service for a number of years made intensive studies of impounded water development projects with a view of determining suitable methods for preventing their becoming prolific sources of Anopheles and epidemic outbreaks of malaria Since then a number of states have based their state regulations for mosquito control of impounded waters on these studies. In recent years the sanitary work of a number of companies constructing such projects is carried out both with and without state supervision on a far higher plain than the regulations call for In view of the fact that control of Anopheles could be obtained on these lakes by using aquaplanes for Paris green treatment at possibly from 6 to 10 per cent of the cost of present operations it is thought that impounding water agencies should be encouraged and permitted by state boards of health to use such procedure

It is evident that at present the cost of screening of rural farm tenant homes is reasonable but a less costly procedure is very desirable and should be achieved Also it is self evident that many field workers do not realize the importance of screening as a means of reducing insect borne diseases other than malaria and insufficient effort is being used in this direction

There is a general agreement that we can best accomplish the desired end in malaria elimination or malaria control through the full time county health units assuming that such units will attack their problem vigorously in the field rather than giving it only a verbal attack Such units will find it decidedly advantageous to determine what percentage of the rural public know and understand their personal relation to the malaria problem and also what the malaria control activity and its ramifications are for At present most of them are merely guessing at it

In some counties the medical profession is doing splendid work by advising the families of their rural patients as to what the farmer can and should do toward malaria control but our county health directors have not yet developed the full possibilities of this line of attack

There appears to be considerable difference of opinion yet as to the value of blood slides in connection with practical field work and apparently it will be well worth while for one of our sub committees to devise and make popular a better method of procedure (or a pre treatment) that will bring the parasites into the blood at the time when the blood sample is taken It does not matter if it does take several years to make such a study complete

THE FUTURE MALARIA CONTROL MEASURES

We must cease to be satisfied with our present methods of procedure and devise better less costly and more rapid ones And it should be a part of the work of our Association to interest more field workers and more business men in helping us to bring such conditions into existence

We have not yet worked out any plan for improving the work nor intensifying the interest of sanitary inspectors engaged in malaria control activities This can and should be done by both state and county health departments

One condition that should not exist in the malaria belt in the future is to have full time, well equipped health units in highly malarious counties so ignoring their malaria problem that malaria is contracted at the court house where the health unit is located nor to have numerous gorged Anopheles in and clinging to the building each morning during the malaria season

Such conditions existed this year and the health unit under consideration thinks it has an all round program of procedure

In a number of counties at the present time steps are being taken to prevent the sale of 10 mesh and 12 mesh mosquito wire and of screen doors of similar mesh This practice will soon extend to all states of the South land Steps should be taken to reduce the export of such screen cloth to countries to the south of ours

Among the poorer class of farm tenants in highly malarious counties there is and will be needed cheaper methods of screening and screen protection Investigations along this line have already been made by the full time health unit of Shelby County Tennessee and the results are very promising Also the City Health Department at Memphis Tennessee has recently shown that it is possible to get all property owners to screen all rented negro homes

With regard to drainage activities there is no reason why a (county owned) small suitable tractor cannot be available to the health unit for use in connection with a ditching plough on farm lands and as soon as the demand for minor drainage is sufficiently developed new small ditching machines to reduce cost will undoubtedly develop There is no reason why we cannot have a new type of tile drain that will be lighter cheaper to buy and cheaper to install and less easy to break than the ones now used With the use of small pumps it will be possible to make sumps in territory where ditch grades are relatively flat and thus eliminate unnecessary use of larvicides Also with our present use of Paris green in many cases our small swamps can be advantageously turned into fish ponds or lakes to advantage

When state appropriations are considered or available it will be necessary to see that they are not so subdivided by budgeting and by fixed time limits as to interfere with the progress and the business interests that cooperate must all understand why more can be achieved and better work done by specified flexibility

The work already achieved through the support of the chambers of commerce of East Texas indicates that it is possible and practical to obtain state appropriations and that the rural public can be made to be decidedly interested in malaria elimination

Two control measures that may be used to advantage in the future are mosquito traps to destroy infected *Anopheles* and the use of home grown larvicides We know that waste tobacco stems teas (pyrethrum made from chrysanthemum flowers) and bark of mangle trees all have larvicidal properties and as the larvicidal value of hundreds of other plants has not yet been tested we may expect to have several cheap larvicides that are yet unknown

Merely because oiling by means of knapsack sprayers was found to be suited to conditions at Panama it does not follow that we should cling to that old practice In many states we have large sheets of water to treat where mechanical means of oil treatment should be used and improved upon until better control measures can be developed and applied

In connection with developing a wider public interest in malaria freedom and in mosquito annoyance freedom we should make it more widely known that whether we happen to notice it or not in many states we pay a mosquito tax. In some localities, although we do not know it this tax is in the electric light bill, in others in the cost of cotton production Again there is a considerable malaria tax involved in farm products raised in our Southern irrigation districts as well as a tax attached to products that come from the coastal plains and river valley districts of the countries to the south of us Our Committee can be influential in helping to reduce these unseen but large taxes, and I hope the day will soon arrive when the printed proceedings of this Committee will annually reach every county sanitary inspector engaged in mosquito control activities as well as all the technical schools of the southern republics The Oficina Sanitaria Panamericana has already published much information of practical value and it is possible that within a few years we shall be obtaining more new ideas and new methods of malaria control from the southern republics which gave us our first big start in malaria control It is quite possible that soon our Committee will be an International Malaria Committee in its membership as it already is in spirit.

The outlook for malaria control has never been brighter than at the present time The developing cooperation of associations of business interests is encouraging and it should be a part of our work to see that such activity is made to grow not only all over the Southern states but to the lands of our friends of the southern republics

We as field workers must be constantly on the *qui vive* for improved methods We must have cheaper and better methods of ditching and ditch maintenance in fact a new ditching machine We need cheaper tiling less costly screening of farm tenant homes We must eliminate the idea of fitting a standard plan onto a changing problem containing varying conditions and we must cease to be afraid of hard work and of potential failures

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DISCUSSION (*Abstract*)

Dr H G Tuggle Memphis Tenn—Mr LePrince forgot to state that it was in our County (Shelby County Tennessee) that Dr H R Carter started his health activities back in 1878 and we have a press interview in our files in which he describes the way the sanitarians of that day were attacking their mosquito borne disease

The present County Commissioners of Shelby County as well as the county health officials are thoroughly awake to the importance of all known insect borne disease control measures and not only keep themselves advised as to what we are doing but also see to it that the taxpayers are getting decidedly full value for each dollar expended for applied rural sanitation It keeps us on our toes all the time During the past six

months we have screened 659 homes at a cost of $9.25 per home. These were farm and urban tenant homes. Of course a much larger accomplishment would have been achieved if the present financial stress period had been absent.

We have not yet sold our business interests the idea of the important relation existing between rural applied sanitation and city mercantile prosperity but have made a good start in that direction and intend to build it up on solid foundations.

Regarding present and future methods of control we believe there always will be room for improvement and have sent our best inspectors off to school so they may get the same viewpoint. Also we give them intensive training in selling so they can and do get hard boiled scoffers eventually to come across and sign on the dotted line. We can see the need and the extent of the size of the field for improvement in this important matter of practical instruction for inspectors and feel that our efforts in this direction have given us an enormous return and advise all other county health workers to give this problem the consideration it deserves.

With regard to permanent drainage our County Commissioners have initiated a plan and started the light concrete bottom lining of flat grade ditches within Anopheles flight range of the County penal farm which is a $1,500,000 institution located on a 1,400 acre tract of County land.

While of course we know there is plenty of room for improvement in what we are doing yet we think Shelby County, Tennessee is steering in the right direction. We know the main reason for the success we have achieved is because our County Commissioners are in close touch with what we are doing and do not refuse reasonable requests for improving the health status of the rural districts.

My message to you is: Be sure to sell applied rural sanitation to those who hold or may hold the purse strings and keep them fully advised as to what is going on.

I desire to give you some information that may be of practical use to a few of those present and to many county field malaria workers who unfortunately could not be with us today.

We are successfully collecting and applying in anti larval work crank case waste oil which is collected from garages and filling stations at a total cost of less than 2 cents per gallon.

The annual expenditure for oil employed in anti mosquito activities in Shelby County, Tennessee prior to installation of storage facilities and collection of waste oil exceeded 50 per cent of the total expenses for all anti mosquito and anti malaria activities. Due to this fact and an increase in number and size of the areas in which extensive control work was being done the County Commissioners obtained and installed second hand metal tanks to provide storage facilities for 71,000 gallons of oil (about 1,500 barrels). The total cost of tanks, elevated supports and foundations for same was less than $1,000.00. The savings effected have amounted to many times the original cost of equipment. Furthermore this saving has enabled us to do about five times what we were doing at the same total annual cost.

Further to reduce the expenses and expedite the collection of oil the County Commissioners bought and installed a pump and a power take off on a 1½ ton truck which was already equipped with a 350 gallon steel tank.

Several small metal tanks captured by the County Sheriff from illicit distillers have been donated and are being used at the storage plant to facilitate the handling of waste oil.

The oil storage facilities are located at what is known as Turnpike Oil Plant where it is necessary to maintain steam at all times to heat the oil and to operate a pump which loads the road oils. This convenience enables us to have and operate a steam pump for waste oil at no additional expense to the Health Department. A departure in our storage facilities which enables us to use waste oil without the usual objections, and without adding light oil, is a 15,000 gallon vertical steel tank with a cone shaped bottom which allows rapid settling and separation by gravity of water, the heavier oils and other foreign substances which are found objectionable.

The 15,000 gallon settling tank is filled with oil and two or three weeks are allowed for sedimentation after which time the water and heavy oils are drained from the tank through a discharge pipe connected at the extreme bottom of the cone. Light oils are drained by gravity to all other storage tanks through a connection at the junction of the cone bottom with the side of the tank. Also trucks which are used in transporting the oil are filled with light oils for spraying from this connection.

This method of sedimentation and separation has been very successful and recently the privilege of using the plant for that purpose was extended to the Memphis Health Department. At this time all oils collected by the City and County (approximately 150,000 gallons annually) are delivered to the County Oil Plant for separation of objectionable substances by the gravity system. This method or plan enables us to obtain a good grade of light oil which will spread rapidly and evenly on water surfaces and effectively control mosquito breeding.

As Shelby County has had a rapidly growing dairy industry for a number of years there are many stock ponds that are potential sources of malaria mosquitoes. The County Health Department with the aid of rural school district health committees, has located and stocked 2,300 ponds, lakes and similar bodies of water with mosquito destroying top minnows (*Gambusia affinis*). These ponds are now hatchers of mosquito enemies instead of hatcheries of human enemies as they formerly were. Some of the intermittent ponds have been deepened at one location to protect the minnows by preventing complete drying up during an extremely dry season.

After three years experience in screening and mosquito proofing rural tenant homes we are fully aware of the fact that further studies along the lines of reducing the cost of screening is highly important if we are to succeed in this direction and have 100 per cent of homes screened. Therefore we have taken advantage of every opportunity to reduce the cost of manufacturing screen doors. In a city the size of Memphis several tons of scrap galvanized sheet metal accumulates in tin shops and the operators are usually glad to get rid of this waste. When we started to collect this, we found that the shop owners were paying from $1.00

to $1 50 per truck load to have the scrap galvanized sheet iron removed to the City dumps Since 1929 we have collected and cut into metal triangles for re enforcing the corners of screen doors approximately seven tons of 24 gage galvanized iron which cost us less than $200 00 to collect and cut into triangles and which would have cost us $80 00 a ton or a total of $560 00 which does not include the cost of cutting into triangles.

Specifications of the United States Public Health Service screen door suitable for rural tenant homes were furnished to local screen door manufacturers with an idea of getting them to manufacture a similar door of especially strong construction at a reasonably low price The smaller screen door manufacturers were not interested in the project as they only made up special orders for the better constructed homes at a relatively high price However the leading screen door manufacturing concern agreed to build a few doors which were very satisfactory in every respect except that they proved to be too expensive for the average tenant home The screen door manufacturing company established a differential price for doors which was governed according to the size of the door and which made the average price per door $2 55 without the hardware Making contact with the screen door manufacturers we have observed that their attitude is to manufacture a door that will sell and not especially one that will give service We feel that the screen door manufacturers and the public health workers still have much to learn regarding screen doors and screening

We have had some experience in building screen doors of wooden furniture crates which accumulate in department and furniture stores Many tons of this crate lumber come from Northern states each year to the cities of the malaria belt states It is used for fire wood! We found that the crate material best suited for this purpose is about one inch in thickness and 3 to 5 inches in width Two types of doors were constructed the double type door where the materials are double throughout the entire construction and the single type door where short pieces of wood similar to that used in construction of the door were used to splice on the side rails when it was necessary to join short pieces Extra strong doors with all square joints can thus be constructed (of the double type) 36 inches wide and 105 inches long or even larger

Cost of manufacturing screen doors can be further reduced by the installation of power equipment particularly a power saw which can be bought at a very reasonable cost

We believe that an efficient way to make salesmen out of sanitary inspectors is to have them go through all the details of screening even to measuring homes making and hanging the doors papering walls and ceiling and repairing the floor cracks During the past summer we have conducted a screening and mosquito proofing school in training six county inspectors and eleven inspectors of the City of Memphis Health Department Already we have observed considerable improvement in the work these men are promoting

Working with rural school districts as the unit of operation seems to offer an effective means of arousing interest in matters pertaining to sanitation For a number of years prizes were awarded at the Mid South Fair held in Memphis, to the communities competing in health activities and more particularly mosquito control We feel that the educational value in mosquito and malaria control alone was worth many times the amount of money given in prizes to say nothing of the accomplishments which were really worth while

Coordinated effort between the County Health Department and the County agricultural and home demonstration agents has been a means of securing improvement in rural living conditions Drainage of areas for agricultural purposes and improvement of premises surrounding homes has been obtained through cooperation with the County Home and Farm Agent Joint educational programs have been conducted with success in meetings held in each rural school district throughout the entire County with moving pictures lectures, and so on

When the County Commissioners of Shelby County Tennessee approved of the plan to start a practical school course in applied screening and mosquito proofing of homes we sent out invitations to other counties and states to send the county unit inspectors for a weeks intensive training but the only persons to appear were malariologists from thirteen foreign countries They were well impressed with what they saw going on and particularly with those phases of the activities relative to cost reduction

In addition to the progress already mentioned we believe our County is a little in advance of many others in the following activities

(1) The use of live larvicides that is the pouring of fish like pouring of oil into small Anopheles breeding areas throughout the County as suggested by Dr L O Howard years ago but not used to full advantage

(2) Using county prison labor to concrete bottoms of ditches in rural districts

(3) We are making and have started to use farm tenant home anopheline traps similar to those used at Panama twenty years ago We believe every infected Anopheles that destroys itself is headed in the right direction Also we electrocute the typhoid flies and dysentery flies that go wrong and are headed toward our county prison farm dairy building

(4) Use of electric power in screen door construction

(5) Offering prizes (as inducements) for increased activity by rural school districts in improving sanitary *conditions at farm tenant homes*

(6) Successful and decidedly effective cooperation with the County Home and Farm Agent

I hope that at an early date some satisfactory means will be devised by the National Malaria Committee whereby our American consular representatives detailed to malarious lands in the Eastern Hemisphere can convey to us all any new procedures in anti malaria activities that may develop in their territory so that we may use it in the republics of America Surely it should be possible for our consular service to take as much interest in this important question as the consular representatives of the southern republics represented here today are doing

Dr Victor G Heiser New York N Y —As experience throughout the world multiplies it is becoming increasingly apparent that any one method for malaria control will not fit the widely varying conditions that occur Probably nothing has caused more disappointment than the application of anti larval measures to

situations for which they were unsu ted and the conse quent failure to reduce the malaria rate The control of malaria in temperate and tropical zones in most instances varies very greatly In our Southern states for instance it is nece ary with few exceptions to apply antimalaria measures during approximately only six months of the year whereas in the tropics they usu ally have to be applied throughout the entire year The per od ■ not only double but a situation that continues throughout the year often multiplies by math ematical and ometimes even by geometrical progres sion Then again the tropic downpours of rain create an entirely d fferent set of physical conditions from those we encounter in this climate This means that antilarval measures th t may be very su cessful here may at im lar ■ ts fail under tropical conditions

Another years travel throughout the tropics of the Eastern Hemisphere has brought convincing evidence that there are many conditions in which anti larval measures are impracticable owing to the h gh cost involved As long as enormous prof ts were available from rubber and tin for instance it was fina cially po sible for Malaya to carry out anti larval measures on a hu e cale which reduced the malaria incidence The foregoing emphasizes Mr LePrinces contention that every community hould make every effort to discover or avail itself of suitable knowledge with which to combat its malaria at a cost that is w thin its means After his intimate association for a quarter of a century with control measures for malaria it is easy to understand Mr LePrince s impatience with the slow progre s he reports On the other hand there have been tremendous ucce ses, in which he had a large pa t and these w ll ■ a long way to often the d sappointments Much of the malaria wh ch still re mains s probably of a more diff cult character to control than that which has been successfully dealt w th in the past which makes it all the more necessary to focus attention on increa ed ■ earch to meet the probl ms that t ll rema n unsolved

It is well always to keep n mind that perh ps much may be learned by studying natural control factors There a e many areas in which malaria i decreasing or is disappearing altogether without any conscious measures bein taken to brin about the results We not only need addit onal and better control measures at lowered costs but we also need an enlightened pub lic to support those measu es and in order to ach ve that more nd more public health education s neces sary

Dr L L Williams Jr Washington D C—Mr Le Prince has brought out a po nt wh ch ■ worth empha sizing namely the use of convict labor in rural mala ri l drainage Th s has been very successfully appl ed in Geo gi where Mr Clarkson has secured the co oper t on of county commis.ioners n twenty two coun ties For almo t two years they have been using con vict labor in the rural d tr cts for malarial drainage with con p cuous success

Where sentiment was against the use of convicts for any work other than public roads I have heard the argu ment advanced that it was llegal to use public funds and publ c workers to dra n pri ate property When the ad antages of extend g this type of work to the benefit of all have been sufficiently mpres.ed upon the minds of the go erning body I have seen this argu ment overcome and convicts used anywhere in the county where malar ous problems could be solved with drainage As a matter of fact Mr Clarkson has so well educated his commissioners in this method that they not only have used convict labor for rural ma larial drainage but have become dissatisfied with the slowness of hand work and, in ■ number of counties have purchased and are now using drag line dredges for digging larger outlet ditches

What better use ■ there to which a criminal might be put? To pay the debt he owes society for his crime by improving the public health is to my mind the highest form of atonement

Mr LePrince (closing)—Some of the technical and medical schools of the Eastern universities are giv ing pecial courses in malariology and sanitary en gineering phases of malaria control as well as intensive short courses in sanitary engineering subjects This study ■ supplemented by practical summer field work study in applied sanitation As this method of training enables the tudent better to f t himself for under taking or directing malaria control campaigns in any warm or tropical country to which he may be later detailed it occurred to me that our Southern guests might like to know of it Mo t of them already know of the somewhat sim lar wonderful work already sup ported by and undertaken by the Rockefeller Founda tion The climatic conditions of European countries are not so favorable to the carrying out of similar plans

In 1927 when the sanitary engineers of the United States Publ c Health Service heard from the United States Weather Bureau that the Mississ ppi River would overflow its banks and possibly destroy some of the protection dikes they gave the matter rapid but careful consideration and decided that the best emer gency control mea ure to apply to prevent a post flood period increase of malaria would be to screen as many of the malaria infested farm tenant homes of the counties affected by floods as conditions would permit In 90 days about eight thousand homes we e thus p otected It was assumed befo e the flood oc curred that the aftermath of such acti ty should re sult in a tremendous advance in screening of ten nt homes by land owners and through efforts of full time county health un ts The e emergency plans and conclus ons have proven to be decidedly sound and have made for a decid dly large annual increase in ant malar a act tv n a number of counties Also this activ ty has rece ed most dec ded financial and other p actical and useful support from a large group of American in.ect cloth ■ en manufacturers who are carrying on impo tant investigations leading to reduction of cost of that phase of malaria control

Dur ng this disheartening period of financial depres sion the County Commiss oners of Shelby County Tennessee have deemed it advisable ■ put in or bu ld bottom shell concrete lining in ditches in the mala rious ru al sect ons of their County thus building Anopheles breeding places permanently out of exi.tence and many other counties of other states could advan tageously do similar work right now or attack other problems of rural sanitation Such work so far as pos.ible should be of a permanent nature and so planned as to lead to its own future and continuous extension Hundreds of thousands of dollars will be pent in the next six months to help families whose bread winn rs are temporarily out of employment.

These respectable American citizens do not want any dole nor do they desire charity Many of them would cheerfully give their labor to do "their bit toward permanently improving the rural health conditions of their county in exchange for what food or money is given them

Should such a common sense plan be adopted then let us use an adequate amount of forethought in its execution so that its future value will be continuous

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MALARIA IN MISSISSIPPI AND ADJACENT STATES*

By FREDERICK L HOFFMAN, LL D †
Wellesley Hills Mass

(1) MALARIA IN MISSISSIPPI

The malaria problem in Mississippi presents practically every aspect of the malaria problem as common to different sections of all the Southern states Certain portions of the State are intensely malarious and have been so for many years while other sections are practically free from the disease This may be illustrated by comparative death rates for the white population during 1928 as follows for the Delta counties the average death rate was 73 per 100 000 of population In the adjoining Bluff counties, the rate was 27 6 in the northeastern counties it was 13 9 in the south central counties 7 9 and in the coastal counties 1 9 Almost the same result is shown for the negro population for which I give the rates also for 19 8 as follows Delta counties, 55 4 per 100,000 Bluff counties 50 8 northeastern counties 21 5 south central counties [illegible] 1 and coastal counties 17 7

(2) GEOGRAPHICAL DISTRIBUTION OF MALARIA IN MISSISSIPPI

During 1929 and 1930 the reported cases of malaria in different sections of the State underwent the following changes for the white population only In the Delta counties there was a decline from 10 259 cases to 3 104 cases in the Bluff counties there was a decline from 7 165 cases to 3 595 cases in the coastal counties from 508 cases to 430 cases in the northeastern counties from 22,872 cases to 15 287 cases and in the central counties from 11,359 cases to 8 918 cases In the Delta counties between 1920 and 1929 the number of reported cases of malaria declined from 40 214 to 27 222 while in the rest of the state the number of cases declined from 69 162 to 63 823 The Delta counties mortality declined from 366 deaths in 1920 to 1 8 deaths in 1929 and in the rest of the State the mortality declined from 356 deaths in 19 0 to 188 deaths in 1929 The fatality rate on the basis of the cases reported was therefore much higher in the Delta counties than in the rest of the State where the disease takes on a milder form The decided fall in 1929 is [illegible] a large extent attributed to the drought or absence of heavy rainfall which in Vicksburg for example was 39 62 inches against an average rainfall for a period of years of 51 93 inches

(3) VARIATIONS IN CASE FATALITY RATES

The normal case fatality rate is estimated [illegible] one death in 470 cases but that must be accepted with reserve for regardless of many years of reporting, there are reasons for questioning the completeness of the returns for many sections of the State

Effort is being made to increase the precision with which a diagnosis of malaria is made and the sense in which the term is used Physicians are encouraged to make greater use of microscopic diagnosis, while a practice has been developed which ties up the work with morbidity reporting In addition effort is made to ascertain the proportion of malaria diagnoses given in death certificates which had an ante mortem microscopical confirmation When this practice began in 1929 it was ascertained that 9 2 per cent of the diagnoses had been confirmed. In 1930 this proportion increased to 19.6 per cent

The ratio of cases to deaths must vary considerably for different sections of the State according to the local degree of intensity of the infection In certain section the disease undoubtedly runs a very mild course while in other portions reinfections produce many serious cases which in years past at least led to cases of hemoglobinuria or blackwater fever in very malignant form but that type has practically disappeared with progress in medical attention which now is much better than formerly Something in this respect may be learned from a study of population changes during the last two decades Bolivar County for example which in former years was one of the most heavily infected counties increased in population from 48 905 in 1910 to 71 051 in 1930 Issaquena County in the Delta region shows a decline from 10 560 in 1910 to 5 734 in 1930 Leflor County increased from 38 290 in 1910 to 53,506 in 1930 Sharkey County decreased from 15 694 to 13 877 Simpson County increased from 17 201 to 20 897 and Washington County increased from 48 933 in 1910 to 54 310 in 1930 These population changes are to a large extent affected by the decline of the lumber industry in most of the counties and the migration of negro laborers to Northern states

(4) LOCAL MALARIA CAMPAIGNS

Intensive malaria campaigns have been carried on by the State Board of Health and the Bureau of Malaria Control well deserving of thoughtful consideration on the part of those who agree that no one type of malaria control is suitable for every section infected with the disease In this connection it may not be out of place to quote the principles of procedure agreed upon by the Malaria Conference held in Geneva in 1928 and summarized in a recent treatise on Malaria in Russia in Relation to Soil and Climate by Dr Friedrich Wolter as follows

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Fifth Annual Meeting New Orleans, Louisiana November 18-20 1931

†Consulting Statistician

(1) In the present tate of science the aim of meas ures for combating malaria hould merely be to check it as far as possible as an epidemic disease Any meas ures which claim to do more such as its complete ex tirpation can only be justified under special conditions (2) It is not always necessary to control malaria by a method resting on the knowledge of its transmission by mosquitoes (3) In every country the measures taken for controlling the disease must be preceded by investigations for determining which method is most suitable for the local condition (4) At the present time no one method is to be preferred to all the others in the prophylaxis of malaria

(5) LOCAL MALARIA SURVEYS

In the 1929 report of the Bureau of Malaria Control of the Mississippi State Board of Health is a review of an anopheline survey of the State by Mr Manuel Perez made possible through the cooperation of the International Health Division of the Rockefeller Foundation The review reads in part as follows

In the course of the inve tigation *A quadrimaculatus A punctipennis* and *A crucians* were encountered The three species are tate wide in their distribution but show some difference in their relative regional abundance The former is most common in the physiographical regions (Delta Bluff) where lakes ponds and low moving streams occur The second was commonest in the hilly northeastern and southcentral regions while the latter is most abundant in the south central portion of the State Collections of *quadrimaculatus* were made in all except eight counties

It is interesting to note that the distribution of malaria and quadrimaculatus is co extensive The susceptibility of this species in the State to both natural and experimental infection has been demonstrated by several workers Here as elsewhere in the Southeastern tates, *quadrimaculatus* would appear to be re pon s ble for the endemicity of malaria

Other students of anophelines have discovered *A atropos* and *A barberi* within the limits of the State Both are of very limited occurrence It is not unlikely that *A pseudopunctipennis* is also included in our fauna "

Of intere t is a brief review of conditions at Rosedale located immediately behind the levee on the Mississippi River concerning which it is said

Its tuation is again t the levee and at times of high water there is a great deal of seepage into the town which is inadequately drained Extremely high water prevailed for unusual periods in 1929 and there was heavy *quadrimaculatus* breeding in drift caught in willows in backwater opposite the town The available equipment for Paris green d sting was wholly unable to cope with this situation An unsatisfactory anopheline d nsity de eloped early in the season and was maintained most of the ummer In preparation for 1930 we are having lanes cut through these wallows to permit the free passage of a power boat carrying the high power blower belonging to the Bureau for the more effective distribution of Paris green in this area.

(6) LOCAL MALARIA IN CONTROL ACTIVITIES

The principles of the procedure of the county health unit may be summarized as follows

(a) The ascertainment of the scope and character of the local malaria problem particularly through improving malaria morbidity reporting and by making epidemiological use of the data.

(b) *The education of children* and *adults in the facts* concerning malaria transmission and prevention

(c) The promotion of screening and mosquito proofing of dwellings.

(d) The promotion of minor drainage

Finally attention may be drawn to private malaria control work as emphasized in the report with reference to the efforts of the Delta and Pine Land Company of Scott (Bolivar County) Mississippi as follows

The Delta and Pine Land Company of Scott (Bolivar County) Mississippi has gone ahead with a portion of the program recommended to them by Mr Parker in 1928 Several advisory visits were paid them to ascertain the purpose of the work. From May to September 18 applications for Paris green were made to 12 miles of shore land of Lake Bolivar and 10 miles of ditches A total of 540 pounds of undiluted Paris green was used diluted with lime or road dust The Bureau loaned a high powered motor duster and homelite electric generator for the work of this season on the lake *Oil was applied in the vicinity of the company* headquarters at Scott. They were also loaned the equipment possessed by the State Board of Health for the manufacture of screen doors Five hundred and seventy two doors were made for 167 tenant houses and were installed The management profe ses satisfaction with the results and expresses an intention to continue the work next year

The reports of the Bureau of Malaria Control have not been published They are illustrated by interesting maps, diagrams and statistical tables all of which are essential to the student of the subject In this re pect certain foreign countries are far in advance of the United States particularly British Malaya and Egypt

(7) COMPARATIVE MALARIA DEATH RATES

Recalling a statement in 1928 that the white malaria death rate of the Delta region of Mississippi was 73 0 per 100 000 this may be compared with ome of the rates g en in my address of la t year on the trends of the malaria death rate briefly summarized for the present purpose The European death rate from malaria 1921 1927 was given as 3 6 per 100 000 and for non European countries as 25.3 The rate was as high as 208 per 100 000 for Salvador 1 6 7 for Venezuela 1929 145 9 for the Republic of Mexico and 128 1 for the Republic of Panama In Porto Rico it was as high as 113 in 1929 1930 wh le for Cuba it was only 18 8 for the period 1925 1929

(8) MALARIA IN ARKANSAS

These rates may be compared or contrasted with available rates for the State of Arkansas. In this State between 1921 and 1930 the number of reported deaths from malaria has declined from 1,027 to 683 while the

rate per 100 000 of population has declined from 58 1 to 36 8 The details are given in the table following

DEATHS FROM MALARIA IN THE STATE OF ARKANSAS 1921 1930 RATES PER 100 000

Year	Population	Deaths	Rate
1921	1 767 098	1 027	58 1
1922	1 777 027	824	46 4
1923	1 786 956	756	42 3
1924	1 796 885	700	39 0
1925	1 706 814	646	35 8
1921 1925	8 934 780	3 953	44 2
1926	1 816 743	695	38 3
1927	1 826 672	844	46 2
1928	1 836 601	876	47 7
1929	1 846 530	667	36 1
1930	1 856 459	683	36 8
1926 1930	9 183 005	3 765	41 0
1921 1930	18 117 785	7 718	42 6

(9) MALARIA IN LOUISIANA

In addition to the foregoing I give corresponding information for the State of Louisiana for the period 1925 1930 In that State the rate has declined from 13 4 per 100 000 of population in 1925 to 8 5 in 1930

DEATHS FROM MALARIA IN THE STATE OF LOUISIANA 1925 1930 RATES PER 100 000

Year	Cases Reported	Deaths	Rate
1925	828	252	13 4
1926	984	211	10 9
1927	2 194	269	13 6
1928	1 789	251	12 4
1929	1 495	206	10 4
1930	1 096	180	8 5

(10) MALARIA IN MISSOURI

Finally for the present purpose I give the malaria deaths in the State of Missouri which show an increase for the period 1920 1930 from 112 deaths in 1920 to 125 in 1930 The mortality reached a maximum in 1924 with 183 deaths, followed by the next year with 171 deaths

DEATHS IN THE STATE OF MISSOURI 1920-1930

Year	Deaths	Year	Deaths
1920	112	1926	140
1921	151	1927	132
1922	143	1928	151
1923	148	1929	153
1924	183	1930	125
1925	171		

(11) MALARIA IN SOUTHEASTERN MISSOURI

But the returns for Missouri as a state fail to reveal the true nature of the problem since malaria is practically limited in serious form to a half dozen counties in southeastern Missouri as given in full detail in my paper of last year for the period 1912 1929 The rates there shown are extremely high in some cases but all how a decided diminution compared with those of twenty years ago *I will review* the counties briefly by way of explanation Butler County shows a reduction in the malaria death rate from 270.5 per 100 000 in 1912 to 59 5 in 1929 Dunklin County shows a reduction from 349 5 per 100 000 in 1912 to 58 9 in 1929 Mississippi County from 120 1 to 25 6 New Madrid County from 183 1 to 73.3 Pemiscot County from 235 6 to 38 1 Scott County from 132 6 to 28.2 Stoddard County from 222 9 to 50 8 The earlier figures show a fatal incidence of malaria corresponding to the most infectious sections of the globe I made a statement on some other occasion that the earlier conditions in these counties resembled the worst reported for the West Coast of Africa No extended reports are available as to malaria control activities in these counties but it is well known that the chief result is to be attributed to drainage operations on a large scale *and the resulting progress in agriculture which after* all is one of the most encouraging methods of malaria elimination supported by intelligent malaria control measures at the same time The extraordinary decline in the fatal incidence of malaria in southeastern Missouri has not attracted the attention which should be given to a study of the factors chiefly re ponsible for this marked reduction It certainly is most gratifying to find one of the most fertile regions of the globe gradually being improved in healthfulness to a degree where the insidiousness of malaria is no longer a serious factor to be reckoned with At the same time it is obvious that much yet remains to be done to rid these counties entirely of malaria for as shown by the following comparisons for the *five year* period ending with 1929 the malaria death rates in all these counties are still extremely high I give for comparison the average rates for the preceding period of thirteen years ending with 1924

COMPARATIVE MALARIA DEATH RATES MISSOURI 1912 1929 RATES PER 100 000

	Average Rate 1912 1924	Average Rate 1925 1929
Butler County	125 1	73 6
Dunklin County	176 6	57 7
Mississippi County	49 9	51 9
New Madrid County	74 6	53 1
Pemiscot County	105 1	53 2
Scott County	47 2	21 2
Stoddard County	92 8	62 8

(12) DECLINE IN MALARIA DEATHS IN MISSISSIPPI

Returning now to a reconsideration of the situation in Mississippi I present below a table of the morbidity and mortality rates for the total population 1914 1930

MALARIA MORBIDITY AND MORTALITY RATES STATE OF MISSISSIPPI RATES PER 100 000

Year	Case Rate	Death Rate	Year	Case Rate	Death Rate	Year	Case Rate	Death Rate
1914	6 516	57 3	1920	6 590	40 3	1926	3 739	21 2
1915	8 569	83 1	1921	6 687	53 1	1927	4 542	21 9
1916	8 855	79 5	1922	5 764	39 2	1928	5 030	26 5
1917	7 848	55 7	1923	5 129	31 2	19 9	4 580	15 8
1918	5 903	44 1	1924	4 260	19 5	1930	2 461	13 9
1919	6 281	36 4	1925	3 786	21 6			

Since the returns for the white population are probably more accurate than those for the total population including a large proportion of negroes, I give the white

rates for the State of Mississippi separately in the next table

MALARIA MORBIDITY AND MORTALITY RATES STATE OF MISSISSIPPI RATES PER 100 000

(White Population Only)

Year	Case Rate	Death Rate	Year	Case Rate	Death Rate	Year	Case Rate	Death Rate
1914	6 220	38.2	1920	6,320	22.7	1926	3 904	13.5
1915	8 850	61.9	1921	6 548	36.9	1927	4 634	13.7
1916	9 280	61.1	1922	5 84	27.9	1928	5 588	17.5
1917	8,340	41.1	1923	5 253	20.9	1929	5 311	12.3
1918	6 010	24.1	1924	4 525	11.0	1930	3 145	10.0
1919	6 240	24.4	1925	3 995	11.5			

Here is evidence of considerable progress in the gradual control of the malaria situation as it concerns both the white and the colored population The whites are shown to have a somewhat higher rate of case incidence which is probably the result of better reporting while the death rates throughout are decidedly higher for the negro population In 1930 for example the white death rate from malaria was 10.0 per 100 000 while the negro death rate was 17.8

(13) INTERNATIONAL MALARIA DEATH RATES

In response to a suggestion from Sir Ronald Ross that I add some serial data for malaria for different localities to my discussion I give a few returns covering the last ten to twelve years which may be of interest I give the rates per 100 000 estimated population for the period under review

MALARIA DEATH RATES IN DIFFERENT LOCALITIES 1919 1929 RATES PER 100 000 ESTIMATED POPULATION

Year	Calcutta	Ahmedabad	Bangalore	Bombay	Bareilly
1919	137.5	567	55.5	23.1	
1920	143.9	875.2	74.4	26.9	
1921	133.7	839.4	60.5	45.5	25.2
1922	118.9	564.0	66.4	40.4	102.4
1923	117.8	410.7	90.8	33.0	89.8
1924	145.0	595.5	39.5	39.4	95.7
1925	186.7	480.7	47.1	46.1	88.9
1926	155.3	986.0	18.5	49.6	93.1
1927	135.5	1007.9	13.5	8.1	167.8
1928	124.9	1071.2	6.7	22.7	161.9
1929	86.1	1440.5	5.9	16.6	130.1

Year	Kingston Jamaica	Trinidad & Tobago	San Juan Porto Rico	Havana Cuba	U S Reg Area
1919	46.3	[illegible] 1	19.9	5.2	3.8
1920	35.0	222.2	27.2	5.4	3.6
1921	57.6	242.2	27.0	6.1	3.6
1922	19.0	225.3	17.1	9.2	3.6
1923	23.4	01.4	9.3	7.5	2.8
1924	40.0	199.2	15.5	4.1	2.5
1925	80.9	206.3	12.7	4.8	2.1
1926	33.1	09.7	20.2	4.2	1.9
1927	29.8	167.1	12.6	2.9	2.7
1928	39.7	218.1	14.7	4.1	3.5
1929	14.3	161.9	10.8	1.4	3.6

The foregoing table exhibits some extraordinary contrasts justifying the conclusion that the malaria problem in intensive malaria centers of the world is yet far from having been solved At the same time there is convincing evidence of progress in certain sections and localities which cannot be set aside by disconcerting evidence from other sources Comparing the death rates for certain intensive malaria centers with those of Mississippi and other Southern states at the present time we may well congratulate our own health departments which are gradually producing results of a gratifying kind It is, however regrettable that the most affected area that of southeastern Missouri should continue to be neglected for as a matter of fact we are without any extended illustrated reports of what has happened in this infected region in former years and what is being done on a promising scale at the present time to reduce malaria to more moderate proportion. To visualize the problem I will recapitulate certain conclusions giving comparative malaria death rates in the order of their importance for Missouri Arkansas Mississippi and certain foreign countries

COMPARATIVE MALARIA DEATH RATES PER 100 000

Ahmedabad India 1929	1440.5
Trinidad and Tobago 1929	161.9
Philippine Islands 1928	135.8
Bareilly India 1929	130.1
Republic of Mexico 1926 1929	126.9
Calcutta India 1929	86.1
Butler County Missouri 1925 1929	73.6
Stoddard County Missouri 1925 1929	62.8
H[illegible] County Miss 1925 1929	57.7
Pemiscot County Missouri 1925 1929	55.2
New Madrid County Missouri 1925 1929	53.1
Mississippi County Miss 1925 1929	51.9
State of Arkansas 1926 1930	41.0
Scott County Missouri 1925 1929	21.7
Bombay India 1929	16.6
Kingston Jamaica 1929	14.5
San Juan Porto Rico 1929	10.8
L[illegible] 1930	8.5
Bengal India 1929	5.9
U S Registration Area 1929	3.6
Havana Cuba 1929	1.4

(14) MALARIA IN MEXICO

As regards the Republic of Mexico I give the facts in tabular form for the four years 1926–1929 for both sexes combined

MORTALITY FROM MALARIA IN MEXICO 1926 1929 RATES PER 100 000

Year	Population	Deaths	Rate
1926	15 050 700	21 692	144.1
1927	15 194 040	20 091	132.2
1928	15 337,380	18 851	122.9
1929	15 480 720	16 859	108.9
1926 1929	61 062 840	77 493	126.9

(15) MALARIA IN THE PHILIPPINE ISLANDS

The preceding table shows a progressive decline in malaria deaths in the Republic of Mexico from 21,692 in 1926 to 16 859 in 1929 and in the rate from 144.1 per 100 000 to 108.9 while the average for the four years was 126.9 To this I add a table showing malaria in the Philippine Islands for the ten years ending

with 1928 giving both the actual deaths and the rates per 100 000 of population

MORTALITY FROM MALARIA IN THE PHILIPPINE ISLANDS 1919 1928 RATES PER 100 000

Year	Population	Deaths	Rate
1919	9 478 929	37 726	398 0
1920	9 627 450	29 653	308 0
1921	10 081 267	[illegible] 407	281 8
1922	10 547 349	27 100	257 8
1923	11 067 117	24 142	218 1
1924	11 234 415	[illegible] 740	232 9
1925	11 401 708	24,329	218 4
1926	11 568 994	24,368	10 6
192	11 736 286	19 520	166 3
19 8	11 903 579	15 925	133 8

Comparing the number of deaths from malaria for the ten years ending with 1918 with the ten years ending with 1928, it appears that during the first decade there were 264 641 deaths against 57 910 during the [illegible]t decade or 522,551 for the twenty years uggestive of the great prevalence of the disease regardless of continuous efforts on the part of the health department to bring it under better control By reviewing the last twenty years it appears that the rate has declined from 473 6 per 100 000 in 1906 to 133 8 in 1928 the lowest rate on record

(16) CONTROL MEASURES IN THE PHILIPPINE ISLANDS

The various procedures of control measures as followed in the *Philippine Islands* are described in the annual report of the health department in charge of Dr Jacobo Fajardo for the year 1928 just issued In cooperation with the International Health Board a section of malaria control was created in the Philippine health service in 1926 and control measures have been concentrated upon the use of Paris green eliminating anopheline breeding places It [illegible] said however that after two years of field and laboratory observations it was found that the results were inconclusive as to the effectivity of Paris green control In some places they are controlling the disease with the use of quinine and in others with plasmochin compound leaving the mosquitoes alone

Summarizing the foregoing observations it appears that the malaria problem is still far from being systematically attacked by all known agencies in a manner likely to produce far reaching and permanent results But progress is being made gradually and the difficulties are being surmounted No experience in this respect is more convincing than that of the United Fruit Company to which I made extended reference in my report of last year According to the annual report of the United Fruit Company just published malaria per 1 000 employes per annum admitted to hospitals 1925 1930 has diminished as follow with a single exception In the Colombia Division the rate increased from 95 7 in 1925 to 102 5 in 1930 in the Costa Rica Division it decreased from 156.8 to 67 02 in the Guatemala Division from 325 1 to 133 7 in the Panama Division from 230 4 [illegible] 40.2 on the Tela Railroad from 184.5 to 110 4 on the Trujillo Railroad from 259.5 to 167.0 in the Banes Division from 522 6 to 15 7 in the Preston Division from 242.3 [illegible] 12.3 while in [illegible] the divisions combined the rate decreased from 39 to 84.8 Here then [illegible] unquestionable evidence of substantial progress illustrating the value of an organized system of thoroughly competent methods of supervision The more the lessons of the United Fruit Company s experience in the tropics are taken to heart by malaria officers of the outhern United States, the more conclusive will be the results of local control measures. The evidence conclusively proves that we are yet far from having reached a position where we can rest content upon past achievements while the only hope for permanent control lies in the continuity of efforts unremittingly applied to whatever the local problem may be

In closing this report I wish to give expression of my profound sorrow at the recent deaths of Dr W A Deeks, Chief Medical Director of the United Fruit Company Dr Aristides Agramonte of Cuba, Dr Oscar Dowling of New Orleans, and Dr [illegible] G Williams Health Officer of Virginia In the deaths of these four outstanding personalities the cause of malaria control and control of tropical diseases has sustained an irreparable loss Gradually the pioneers in malaria control are passing and it is for the new generation [illegible] take the lessons of the past seriously to heart and in this direction no student of malaria can ignore the great work of Sir Ronald Ross and the long list of valuable contributions of that distinguished scientist to the cause of malaria causation prevention and control

(17) THE ROSS AWARD FUND OF AMERICA

As a member of the Ross Award Fund of America I therefore close the discussion with an appeal to all those interested in the *ramifications of the malaria* problem to lend their aid in making this Fund a contribution to the great work of Sir Ronald Ross, which may be thought of otherwise as the greatest medical achievement of the past generation Those interested in this Fund which is being raised in this country should communicate with Dr *Robert L Pitfield* Secretary Ross Award Fund of America 5211 Wayne Avenue Germantown Pennsylvania

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DISCUSSION (*Abstract*)

Dr Felix J Underwood Jackson Miss—From the records of our malariologist Dr George E Riley trained by Dr Boyd while he was in Mississippi, I gathered these statistics. In eight months from January through August 1931 there were reported in Mississippi [illegible] deaths which were ascribed to malaria as against 187 in the same period of 1930 Dr Hoffman gave it as 188 a discrepancy of one There were [illegible] deaths as against 187

Of these deaths in 1930 32 or 17 1 per cent were confirmed by microscopic examinations, while in 1931 of the 8 deaths reported 19 or 23.3 per cent, were confirmed and ten physicians have not been heard from yet

In the same period of 1929 185 deaths were reported of which only 6 or 3 2 per cent were verified

It appears that some progress is being made in the specific and precise diagnosis of malaria

For the period considered the mortality reports indicate a considerable reduction in malaria over 1930 This reduction hold true for each of the physiographic regions of the State and is reflected by the diagnostic laboratory examinations and the statement of practising physicians that the malaria incidence in 1931 is lower than even that of 1930 and perhaps the lowest on record

The eight diagnostic laboratories examined only 9 196 slides with 790 or 8 6 per cent positive in 1931 as against 13 293 slide with 1 751 or 13 2 per cent positive in 1930 durin the same period

The malaria program in Mississippi is executed by through and with the full time county health departments and is directed to the rural problems *It has* been developed with a full appreciation of the meager resources and varied responsibilities of these organizations It is realized that satisfactory results will require continuously sustained effort and support over a number of years This program was developed and adopted in 1929 and the first two years operation has demonstrated its workability

The Delta and Pine Land Company referred to by Dr Hoffman discontinued its malaria program this year with the statement that it preferred to invest in screens and minor drainage rather than in larvicidal control of mosquitoes

The minor drainage activities have advanced steadily since 1929 In July 1930 a second engineer was employed and recently two additional engineers have been added to the staff From January 1 to October 31 1931 125 83 miles have been surveyed and 42 84 miles of ditches reported installed *draining 4 153 8 acres*

Let me again mention and stress the importance of minor drainage which makes our major drainage function for as Dr Hoffman has said drainage operations and the resulting progress in agriculture is one of the most encouraging method for the control and elimination of malaria when supported by intelligent malaria control measures at the same time

In addition to the insertion of a negro version into the Rockefeller Foundation motion picture film Malaria the Division of Malaria Control has developed a plan of *cooperation with the State Vocational Board* of Education whereby its bulletin on the Why and How" of screening and mosquito proofing of houses is used as a text in each of the 348 vocational and trade schools of the State

These vocational students will be taught by practical demonstrations the manufacture and installation of the standard screen doors and methods of mosquito proofing homes

The outlook for 1932 is regarded with concern It is desired to maintain the natural gains of 1930 and 1931 but the low price *of cotton and the general eco*nomic depression will make it difficult to accomplish

From January to August the number of deaths in the Delta was for 1930 78 and for 1931 40 The rate *per 100 000 18 6* in 1930 and 9 7 in 1931 For the State in 1930 there were 187 deaths, and in 1931 82 The rate per 100,000 in 1930 9.3 and 1931 4.0

Dr Hoffman (closing)—I have *been familiar with* malaria conditions in the South for more than thirty years. Conditions in Mississippi thirty years ago were dreadfully bad but as Dr Underwood points out malaria in Mississippi is slowly becoming a vanishing disease *Mississippi has done excellent work particularly* during recent years with tendencies in the right direction provided there is no falling off in public support. Mississippi has been fortunate in state health officers who have always clearly realized the supreme importance of malaria control To bring about far reaching results there must be whole hearted cooperation between State and local authorities as well as business corporations interested in the economic aspect of malaria prevention It is to be hoped that there will be no curtailment in appropriation but rather a more liberal *extension of public support towards control meas*ures which generally speaking rest on sound principles of procedure

SCREENING IN SHARKEY COUNTY*

By A K BARRIER M D,
Rolling Fork Miss

The remarkable progress of screening in Sharkey County can be attributed to several things Probably Dr Boyd's enthusiasm had as much to do with it as anything else and has made it seem larger to him than it really is

Sharkey County is situated in the central western *part of the State separated from the Mississippi River* by Issaquena County about twelve miles wide It runs north and south about forty miles and eastward from Issaquena County about twenty five miles to the west bank of the Yazoo River It with Issaquena County and the northern part of Warren County lying between the Mississippi and Yazoo Rivers, form a natural reservoir for the high waters from the *Mississippi* River It is a level area devoid of hills, full of lakes, bayous and marshy places suitable for the growth and development of mosquitoes. Very few houses in the County are not within communicable distance of some mosquito breeding places so we can safely assume that all the inhabitants are constantly exposed to malaria unless they are mechanically protected

Our little towns until a few years ago were frequently visited by the more malignant forms of the *disease and even now when the house is not protected* by screens the dread monster intrudes

I came to Sharkey in 1903 At that time I do not think 5 per cent of the houses in the County were screened I was appointed part time health officer in 1913 at a salary of $300.00 per year I immediately began fighting the mosquito It had cost the County much life property and money and had impeded progress more than all other agencies combined

I decided then that our only hope was to screen our homes. Of course we could cut down the inci

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty Fifth Annual Meeting, New Orleans, Louisiana, November 18 20 1931

dence by drainage removing the water barrel which was used for a cistern and destroying the minor breeding places adjacent to the home

Realizing that education was the sheet anchor of all progress I began to talk privately and publicly wherever opportunity afforded teaching white and black adults and children that the spread of malaria depended on the human and mosquito cycle through which the malarial parasite passed and that if this cycle could be broken the problem would be solved that the destruction of the mosquito or keeping the human being from coming in contact with mosquitoes would accomplish this, and that proper screening of our homes was the most logical as well as the most sensible thing that could be done We taught them that there were different varieties of mosquitoes and that the Anopheles that frequented our homes and made its depredations at night was the only one responsible for malaria that the mosquito that is in evidence during the day is not responsible for the infection

During the first year or 1914 the gospel had been so extensively spread that one merchant told me he had sold more screen wire during that year than in all previous years

I continued this program with moderate results until after the recession of the flood of 1927 when the Red Cross very generously screened between three and four hundred homes This had a very wholesome effect on our people It caused them to stand with outstretched hands beckoning for more help Those whose houses were not screened wondered why they were slighted and wondered how long before the Good Samaritan would return

After this educational work had shown the benefits of screened homes Dr Boyd came along in 1929 or 1930 I told him that I thought the only logical way to decrease the incidence of malaria was by screening our homes to which he readily consented Further to impress the negro with the importance of the work Dr Boyd let us have a moving picture outfit showing the life and habits of the mosquito his relation to malaria proper and improper screening of homes We carried this moving picture to different communities throughout the County This seemed to impress the negro very perceptibly

We were then in a position to approach the planter about the work We showed him the cost in sickness loss of time doctors bills and funeral expenses We proved to him that it costs very little more to screen a home which was a permanent protection for three or four years from flies as well as mosquitoes day and night than to furnish mosquito netting for the beds which would last only one season which at best protected from mosquitoes only during the sleeping hours and not from malaria at all We estimated that a home that cost $10 00 to screen would require $7 50 for mosquito netting for the beds We reminded him that his tenant could give a better day s work after being protected from mosquitoes than when he had them to fight all night that the screened home would not only protect from malaria but would protect him ordinarily from typhoid fever and other alimentary diseases We interested the influential tenants who went to the planter and requested him to screen their homes We also suggested that the farmer have the work done and charge to tenant to be paid for at the end of the year just as they do when they furnish the bars This suggestion was very satisfactory to both planter and tenant Most of the houses were screened on this plan

In 1930 the State Board of Health made an arrangement with a firm in Jackson to build and deliver the screen door complete at $2 00 per door This included all hardware and facing for the door The screening for the windows was bought in the open market The inspector measured doors and windows and made an estimate of cost We also secured carpenters whom we trained who agreed to erect the doors and put screen on the widows at a stipulated price 25 cents per door and 10 cents per window which was better than having it put on by the ordinary plantation carpenter

The inspector superintended all of the work and none was paid for until checked by him In one community where we had a Smith Hughes school we interested the boys and they did a great deal of the work as a result of which we had more screening in that community than in all the other parts of the County On account of the work done here the teacher of the class was made master teacher by the State Extension Department of the United States Department of Agriculture for the most efficient work done by any Smith Hughes school

We have proposed to the Smith Hughes Department to erect a small plant at which they will be able to build doors themselves for the adjacent plantations, to which they have agreed

We started out in 1931 in the face of discouragement Money was scarce and everybody disheartened Many said we could do nothing on account of the prevailing financial depression but we concluded that we needed the work worse than ever that we were in no condition to cope with disease The poor man could better afford to pay a small sum for screening than to lose time from sickness paying doctors bills, funeral expenses and so on

The doors which were made at Jackson did not come to the standard frequently were made of inferior material Hence we prevailed upon a local firm to erect the necessary equipment for building doors under our supervision We have had constructed a much better door which has given entire satisfaction made by order of the sanitary inspector After measuring doors and windows of all the houses on the plantation each door was properly marked so that we could know for what house and which side of the house it belonged

The firm which was building the doors proposed to finance the work by waiting on the planter for pay

until fall Of course he selected the men whom he proposed to finance This encouraged some men to have the work done who probably would not have done it if they had had to pay cash for it Thus prepared we could confidently approach the farmer This work requires salesmanship It requires tact common sense patience and perseverance to sell anything Dr Canover of John Smith University in one of his annual addresses to the graduating class, advised the young men to spend their vacation with a good salesman and learn the art of meeting people and selling wares I am sure this would be good advice to the health worker As a result of our labors in 1930 we measured built and placed 1 476 new screen doors renovated or rebuilt 580 old doors and screened 3 570 windows completing 683 houses Eighteen farms were 100 per cent screened In 1931 we measured built and placed 5 8 doors screened 1 392 windows renovated 257 old doors completing 275 houses With the screening that had already been done three fifths of the homes in the County are now screened I am sure that if it had not been for the financial depression we should have been able to screen nearly all of the homes durin 1932 On one plantation of 12 000 acres with 612 homes where in 1929 before screening there were 179 cases of malaria, in 1930 after the screens were finished there were only 17 cases of malaria and there had been no deaths This plantation has also been entirely free from typhoid fever

I wish also to state that the negro appreciates and is taking about as good care of the screens as the average white man We have had with us since August 1930 a civil engineer furnished by the Rockefeller Foundation and the State whose time has been divided between three counties He has been doing good work showing the farmer the best mode of getting rid of ponds lakes and other small bodies of water thereby not only benefiting the land but destroying breeding places for mosquitoes Some conditions *of which the cost of correction had for years* seemed prohibitive were surveyed and corrected The following will give an idea of the results of the engineer's labor

During the period from August 1930 to August 1931 50 surveys have been made or a total of 121 909 feet 28 520 feet of ditching has been done draining and benefiting *421 acres of land at a total cost of* $484 00 or an average of $1 15 per acre There are other ditches now in progress which will be completed before this paper is read

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DISCUSSION (*Abstract*)

Dr Geo E Riley Jackson Miss—Dr Barrier has very aptly described Sharkey County as a natural reservoir during high water and a low level area full of lakes, bayous, lagoons and marshes during normal times It thus affords an abundance of mosquitoes mostly quadrimaculatus even in the driest years Its mean elevation is less than 100 feet above sea level It is in truth the most fertile garden spot of the entire Delta and yet a great portion of it is practically worthless because of its backwaters The population of Sharkey County is [illegible] 877 There are three towns Cary Rolling Fork and Anguilla with a combined population of 1 788

The general economic depression of which we have heard so much this year has been experienced by Sharkey County since the flood of 1927 In 1928 and again in 1929 the backwater was upon this County and then came the great drought of 1930

In the face of these condition Dr Barrier said carry on At first no doors could be sold because there was no money Dr Barrier and his inspector Mr Gathn paved the way by interesting a local lumber company in the manufacture of screen doors They then asked for a list of every person in the County to whom the company would extend credit until fall With this list a field ripened by previous education of the people and a salesman like approach 835 doors were installed and 275 houses were completely screened As a result of this credit arrangement the same lumber company in Washington an adjacent county operated under the same plan and the Washington County Health Department was able to screen 205 houses using 503 doors I believe that it was through the possibility of this credit system that the 484 houses and 1,355 doors in these two counties were screened

Both counties had extensively used the negro version of the Rockefeller Foundation film Malaria" the screening posters and bulletins of malaria and screening

The plantation carpenters as has been said had *proved of very poor quality therefore regular car*penters were employed and were paid 10 cents for each window 20 cents for each door and 5 cents for each chimney In many instances a door facing had to be made or remodeled An additional charge of 20 cents was made for this The average cost per house including lumber for door facings and labor was $10 50

The subject of screening is being taught in 385 vocational and trade schools of the State One of the vocational schools in Dr Barrier's county is now making 150 standard screen doors which will be sold at $1 55 This is being done by the teacher who was made Master Teacher not only for his educational work but in a large measure because of the interest manifested in health work and the fact that all his students were immunized against typhoid smallpox and diphtheria

A recent survey of 961 houses in Sharkey County revealed that 618 or 64 3 per cent were screened.

In regard to the engineering service I can say that in the 14 months there has been a steady increase in the demand for this service In one instance where drainage was impossible a marsh area was cleared and a dam built converting the area into a fish pond which is well stocked with fish

I should like to call attention to the fact that Dr Barrier an inspector and two nurses serve two counties and carry on a well rounded program In the face of conditions that exist in this County and which have existed for four years, I think that Dr Barrier is to be congratulated for the progress made

PUBLIC HEALTH A BUSINESS PROPOSITION*

By HENRY W STANLEY,†
Dallas, Tex

Chambers of commerce like many other organizations, have been going through a period of transition A short decade ago the civic employe who could shout most loudly about only the virtues of his community or city was hailed as a great civic leader Fortunately, for the community good the day of the bombastic artist has passed In his stead stands a man acquainted with facts and the laboratories of science looking for the good to exploit and the defects to correct

Ten years ago it would have been impossible for a chamber of commerce representative to have discussed public health much less such a mooted question as malaria control His remarks would have been frowned upon at home and his attitude would have been regarded as detrimental to the best interests of the community

Today the American Public Health Association not only enjoys the support and cooperation of the greatest of chambers the Chamber of Commerce of the United States but is finding opportunity to extend its valued service to hundreds of local chambers through the Health Conservation Contest in which nearly three hundred cities are annually enrolled

Fresh from his conquest of Panama Mr J A Le Prince came to Dallas Texas and started the first malaria and mosquito control campaign in 1917 The work was placed under the direction of Mr H W Van Hovenberg who has since then written a brilliant chapter in sanitary engineering as Chief Sanitary Engineer of the St Louis and Southwestern Railroad The going was slow in the early years of the campaign As results became more noticeable it was made a major project of the City Health Department a place which I am happy to say it still enjoys Dallas is not only proud of her leadership in finance commerce and industry but takes pardonable pride in being among the first of Southern cities to overcome its malaria problem

A chamber of commerce is composed of a group of alert progressive business and commercial leaders of a community who have found in it a piece of machinery necessary to the development of commerce and industry Such a group would of course be vitally interested in the saving of dollars as well as the creation of new wealth from farm and factory I have yet to meet a chamber of commerce that could by the most liberal use of the term be called a humanitarian body

We have dedicated our services to the promotion of public health because it is good business to do so

I have been informed through a survey recently made by the University of North Carolina that sickness, illness and death from preventable disease is costing the United States more than a billion dollars annually

A few weeks ago we were told through a great nation wide campaign that the annual fire loss amounted to the huge sum of $500 000,000 It should be of first page importance to us that needless sickness is sacking our resources at the rate of a billion dollars a year or twice the annual fire loss This loss reaches down to the average citizen at the rate of $8.30 per capita My home town is paying out two and a half million dollars a year for the privilege of being sick. For the State of Texas it amounts to nearly $50 000 000 a year Nor do we enjoy poor health in Texas, either

We know too that when the bread winner is ill from any cause earning power is often curtailed and in some instances stopped entirely in which case we have a non producer which strikes a telling blow at the entire and elaborate system of merchandising

Our second reason for interesting ourselves in a program of life and health conservation is to maintain the efficiency of the worker The ever increasing number of industrial accidents, on which organized business must pay a compensation insurance premium is giving us real concern

A saw mill accident came to my attention a few weeks ago The mill is paying a very high premium to protect its employes payroll This very high rate is based on the experience of the mill Last year three men were killed and several more injured in a boiler explosion The fact finding committee that attempted to ferret out the reason for the explosion reported it was caused by the neglect of the fireman watching his boiler Going a little further to the company physician we found the fireman was suffering from malaria You may draw your own conclusions as to the cause of the accident

Malaria is a rural disease Our cities and towns have done a good job of mosquito control and have reduced the malaria rate to a very low figure In the rural sections of the South malaria still exists as our most impoverishing disease

From the last census I find that 996 537 people live in the rural sections of the 56 counties that lie within a 100 mile radius of the City of Memphis Tennessee in the states of Mississippi Missouri Arkansas and Tennessee A recent survey in which blood specimens of 4 662 school children were examined indicated that 10 8 per cent were malaria victims I have no doubt that the actual infection would be much higher However taking this for a basis for study we find that 107 635 people living within 100 miles of Memphis have malaria annually It has been said that each case represents an economic loss of not less than $25 00 often much more At the rate of $25 00 per case the eco

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Fifth Annual Meeting New Orleans Louisiana, November 18 20 1931

†Director Trade Extension Division Chamber of Commerce

nomic loss in this instance amounted to $2 680 625 00 This amount was taken from the channels of trade

In one Mississippi county it is estimated that the malaria loss is equal to one third of the annual county taxes. *These facts I hope* will serve to give you a glimpse of the tremendous loss this one preventable disease is causing each year and will continue to cause until it is brought under control.

Three decades ago J A LePrince and Major W C Gorgas and their associates flashed the news to the world that yellow fever and malaria were preventable. They proceeded without delay to prove their statement in the now historic and romantic campaigns of Havana and the Panama Canal Zone. The United States has just reason for being proud of Mr LePrince as a citizen of the country but for his contribution to science and his work in the relief of suffering humanity the world claims him

As a business proposition we have learned in Dallas Texas the largest inland cotton market of the world that we can not grow cotton on Main Street nor does *it thrive among our towering skyscrapers. We have* therefore interested ourselves in the hitherland. We modestly admit our interest in malaria control for purely commercial reasons. It was my pleasure while associated with the East Texas Chamber of Commerce a great regional organization serving 71 counties in East*ern Texas* to cooperate with others in sponsoring a bill that passed the forty second Texas Legislature and was signed by Governor Ross S Sterling appropriating $50 000 for the specific purpose of malaria control and empowering the State Department of Health and the United States Public Health Service to launch such a campaign. I am happy to tell you that it is now under way and is showing some very pleasing results. In rural meetings Mr Chester Adams and his associates in the field are having from 300 to 1,200 farmers night after night attend their meetings to see and hear the story of malaria and its control. Educational work is now under way in perhaps 30 counties while active screening is being conducted in five of the counties that showed a heavy infection

The St Louis and Southwestern Railroad has in my estimation paved the way for other commercially minded bodies to follow in malaria control. Mr Daniel Upthegrove President of the line, will tell you of the saving of hundreds of thousands of dollars which this work has returned to their stockholders. He will tell you of a happy contented group of employes an asset that cannot be measured in dollars and cents. This work is now under the direction of Dallas first mosquito expert Mr H W Van Hovenberg

The cost of operating many railroads in southern countries is unquestionably higher than need be because of malaria prevalence. This cost or malaria charge must be borne by the ultimate consumer of products shipped overseas. *We North Americans, being* human are naturally interested in reduction of cost of what we consume and believe such meetings as this may lead to lowering of costs or reducing the unnecessary malaria tax on products raised in malarious river valleys. Also the Southern republics like the Northern one are in competition with the Eastern countries and their very cheap labor and must eliminate all unnecessary malaria expenses. If your countries undertake studies leading to malaria elimination you will undoubtedly see the value of having as a start small national or state appropriations spread over a period of from two to five years so the study or demonstration ap*propriation will not be withdrawn before worthwhile* results have been achieved and so that your business interests may be able to analyze critically what you have accomplished and understand beyond a shadow of doubt how they can reduce their production costs.

May I also express my sincere appreciation of the presence here of our friends from the Latin American countries. We are indebted to you not only for the inspiration of your zeal in battling tropical diseases but for your contributions to science in the cure of malaria. We are not unmindful of the fact that it was from the Valley of the Amazon that quinine was brought to the scientific world as the only known specific for the cure of malaria

By the bonds of cooperation welded in this great enterprise of life and health conservation we hope to weld even stronger bonds of friendship and goodwill. Your presence here is indeed an inspiration

From a recent survey made by the Child Labor Committee of New York in certain Southern communities, we learn that 35 per cent of the rural people are sick at some time during the year. They lose an average of 26 days a year from illness. Their medical expenses *average $42 99 per person. Mortality rates are very* high

We believe that there is something physically wrong with a man who will stick his arm in a fly wheel or drop hammers on his feet. We urge our industries to have their men examined before they enter employment and further submit to a complete physical examination every six months. Industries which have followed this rule have found that it pays some very handsome dividends not only in life conservation but in dollars as well

Our third interest in public health is for the general public welfare. At great expense the Nation maintains an army and navy for the protection of life and property at home and abroad. For the same reason we urge more attention on the part of organized business to the problem of public health

The day has passed when it is *merely* a shame to be the victim of preventable disease. It is criminal.

If I stand on the porch of my home and fire at a cat in the alley and miss the cat and strike my neighbor killing him I am guilty of negligent homicide. By the same token if I allow disease to thrive on *my property and spread to the home of my neighbor* and assassinate him I am guilty of the same crime. It might be added that any city county state or na

tion that allows disease to stalk its borders unchecked is likewise criminally liable I am my brother's keeper!

We have been very careless in the proper valuation of human life Cattle hogs and sheep are much more respected than men and women boys and girls If foot and mouth disease should break out in a herd of Texas cattle we would spare no expense to stamp out the dreaded disease that was killing our prized animals My State be it said to her shame spends twice as much protecting the livestock as it does in protecting humanity

It is not a new idea to set a price on a human individual In Texas we pay a bounty of $5 000 a head for dead bank robbers The traffic in slaves but recently abandoned in civilized communities reaches back to remote antiquity Dr Louis I Dublin in his book The Money Value of a Man says

It is the cheapness of the slave that made possible the enduring monuments in stone raised by the Pharaohs it is by leisure secured at the cost of slave labor that Greek philosopher and Roman poet became the authors of that more lasting structure classical literature Thus the price of man has played a role of no small importance in history in shaping the world to its present state

According to Dr Dublin we enter life with a known value ranging from five to fifteen thousand dollars The money value of the individual grows as we grow in years and in earning power

Our greatest assets are not in our mines our forests our rivers and our harbors, but in the men and women who control these assets

The East Texas Chamber of Commerce with a membership of 10 000 business men in the eastern part of Texas offers the following work program

(1) A full time county health unit in every county

(2) A tate wide malaria control campaign

(3) The Standard Milk Ordinance in every incorporated town

(4) Safe water safe milk and sanitary waste disposal on every farm

Surely an ambitious program But busine s men are interested in nothing less I often think many of our programs are too small to command the attention they deserve

We further belie e that our goal will be reached with greater dispatch if we concentrate our efforts on one project at a time At present it is malaria control which we expect to use as a stepping stone to a full time health unit

In closing may I read a few lines from an editorial by that dean of editorial writers Mr Bruce Barton?

Every once in a while somebody rises up to criticise modern parents for devoting too much time to their children's physical being Says such a critic Of course the body is important, but it was given us to be disciplined and put down To lay so much emphasis on the physical is paganism Our righteous ancestors disregarded their bodies and paid attention to their souls This is all true and it might be added that by neglecting their bodies in the interest of their souls they beat us to heaven by an average of twenty years. They matured young worried much and died in what we now regard as early middle life

DISCUSSION (*Abstract*)

Mr J A LePrince Memphis Tenn—Some 15 years ago Dallas undertook an antimalaria campaign and the large commercial industries located in its suburbs no longer have the expensive labor turnover due to high malaria prevalence which formerly existed and which is even yet a decided bar to progress and development in some other large cities in our Southern states Soon after Dallas began her campaign Mr Edwin Gould a prominent and far sighted business man of New York City personally financed preliminary malaria control measures in the territory served by the Cotton Belt Railroad in which he was interested This campaign initiated by Mr Gould was so directed and developed by Mr H W Van Hovenberg that several other railroads followed the Cotton Belt Railroad methods in order to increase their annual income A few years ago this group of railroads were pending more money annually on malaria control activities than the legislatures of all states combined appropriated for use of malaria control by state health departments and attention is invited to the fact that it is in every way as difficult to obtain an appropriation from a board of directors of a well managed railroad as from a state legislature

The State Health Officer of Texas like other big business executives, was not afraid to try out a new method of procedure when adequate forethought indicated it would expedite permanent development of rural sanitation in a large section of his State as well as create a demand by the commercial interests of the State for well directed full time county health units

The Chamber of Commerce of the East Texas counties obtained a State appropriation to be used for a period of 28 consecutive months instead of for twelve months only and we can safely consider this departure (the time element) as the most important advance in the conquest of malaria yet undertaken by any state

Most unfortunately the malaria bill as passed by the Legislature of Texas contained an itemized budget with unfortunate restricting clauses which reduced the amount of permanent benefits which may be obtained for each dollar expended. In their efforts to protect State funds the law making officials did not realize they were making it impossible for the field workers to obtain a maximum of permanent beneficial results for each dollar of the taxpayers money expended It is the same mistake that was made twenty five years ago when a non medical commission limited the power and scope of action of Dr Gorgas at Panama

The campaign now under way in East Texas leading toward the conquest of malaria has the continuous support of the Chamber of Commerce of East Texas whose members fully realize that malaria is the most serious of the impoverishing rural diseases. The progress made to date by the field workers is most decidedly encouraging and it would in no way surprise me to see numerous chambers of commerce of other states and other countries in a few years from now

following the procedure inaugurated by the Chamber of Commerce of East Texas

The other republics of America as well as ours have serious malaria problems which interfere with their normal development with railroad operation with industry development and with agriculture

Let us assume that in one of these progressive countries a group of bankers and prominent business men started to develop a plant to manufacture structural steel or some other important industry If imported skilled labor should be used then unless the directors of the industry take adequate precautions it may not be long before the workmen become infected become inefficient the operation costs climb out of all proportion to what they should be skilled labor may have to be temporarily replaced by unskilled labor accidents will follow and financial difficulty may follow much quicker than is anticipated

If the commercial interest of the city where I live should ask me how a hundred thousand dollars could be spent to best future advantage so far as development of the commercial interests and future growth of the city is concerned I should be very conservative in telling them to find a business man like Mr Stanley to analyse the business conditions in their market area To use such a man for a period of four years pay him $25 000 00 a year if necessary but have him thoroughly sell each chamber of commerce and the business men of the city and the towns in the city s market trade area the idea that for continuous progress they must have adequate full time rural health service in the counties of their trade area and must make the conquest of malaria an accomplished fact

Dr J C Anderson Austin Tex—Texas enjoys the unique distinction of being the first state in the Union to make a specific twenty eight months appropriation for malaria control Following a blood survey of some 25 000 school children which revealed a high rate of infection a $50 000 00 appropriation was made by the Forty second Legislature to combat the disease The United States Public Health Service came forward with both men and money and a joint program was launched in that part of Texas embracing some seventy two counties in East Texas having a high malaria rate The program is singular in that it has the continuous generous and very active support of a commercial organization the East Texas Chamber of Commerce whose interest investigations and efforts were influential in the passage of the malaria bill

Headquarters for the Malaria Unit were established in the East Texas Chamber of Commerce Building at Longview Texas The personnel of the malaria organization includes a medical director field director five sanitary instructors and a malaria technician

Four counties were selected in which to start active demonstration work and a sanitary instructor was placed in each The selection of the counties was influenced by (1) the malaria incidence in the county (2) the extent to which the county would cooperate and (3) a desire to locate the instructors so that they might use the county in which they were doing intensive work as a center and work in a radius to include at least four additional counties in their educational programs One sanitary instructor was chosen with a knowledge of office and laboratory work

Various tried and proven measures including gambusia control oiling ditching and drainage were used but since malaria is recognized as a rural problem, stress was placed on screening experience having shown that it is the quickest and most effective control measure Also it is fully recognized by the State Department of Health that screening of homes is of most decided importance in the practical reduction of other insect borne diseases Screen factories were built in five counties These factories are operated by revolving funds supplied by county local and private interests *The amount of the fund in each county varies* from $500 00 to $1 500 00 Orders for screens are taken by the sanitary instructor the houses measured up and the screens made according to United States Government specifications at the screen factory and then hung under the supervision of the sanitary instructor The screens are sold at cost to the farmer and he has the privilege of paying for them when his crop is made The average cost of screening a farm home *varies from $10.00 to $12 00 Extensive work has also* been done in screening repairs Holes have been patched large size mesh painted to decrease the size of the mesh frames straightened and openings properly covered to eliminate cracks and crevices

Through the courtesy of the Cotton Belt Railroad in loaning us its exhibit truck which is equipped with motion picture machine phonograph and amplifiers, a series of educational programs are being conducted in the rural districts The programs are chiefly motion picture films interspersed with some speaking With this equipment we have already visited sixteen counties and reached approximately 32 000 persons

Our malaria control unit is receiving splendid cooperation from the county agricultural agents, the State Agricultural Experiment Station and the Agricultural Agent of the East Texas Chamber of Commerce

Prior to launching a course of study in malaria in the schools, members of the Malaria Unit met with and addressed the teachers at their annual institutes in twenty three counties It is estimated 3 000 teachers attended these institutes

Permission was given to the State Department of Health to reprint Dr H R Carter s primer Malaria Its Cause and Prevention for use in the schools Twenty thousand of these pamphlets were printed and the work of distributing them to the fifth sixth seventh and eighth grades in the rural schools is under way This program has the endorsement of the State Department of Education and the superintendents of schools in the various counties are assisting the sanitary instructors in the personal distribution of the primers The first distribution will cover 24 counties Malaria essay contests, three minute talks, posters and spelling matches (using words from the primer) have been arranged to stimulate the program

Malaria exhibits were displayed at five county fairs and one district fair

Dr Carter s primer was divided into six lessons, the lessons somewhat condensed and published serially in *Federation News* the official magazine of the Texas Federation of Women s Clubs In a personal message to the 60 000 club women reached with this magazine the State President asked that the lessons be used as a basis of study in the clubs

The malaria control program made possible by the malaria bill enjoys wide spread publicity through the East Texas Chamber of Commerce's magazine the monthly magazine which is sent to the various chambers of commerce and the weekly news releases that go to 211 papers in the East Texas area

An article on malaria was published in the Women's Club magazine each month during the malaria season One entitled Reminiscences of a Doctor's Wife by Mrs S A Collom President of the Woman's Auxiliary of the Southern Medical Association was especially interesting

With a view to getting a laboratory diagnosis of malaria suspects in East Texas and of securing the cooperation of the doctors in the malaria program a laboratory was established at the Malaria Unit headquarters at Longview Mailing containers and slides were placed in the hands of the doctors and they were urged to make use of the laboratory facilities Thirty eight doctors took advantage of this service

In addition to the four counties in East Texas where intensive malaria work is being done Cameron County in South Texas has a full time worker and one assistant doing malaria control work

In the extreme southern portion of Southeast Texas we have the same malaria problem that is common to other Southern states where new irrigation projects are being rapidly extended In this area also *Anopheles albimanus* is present The problem is being thoroughly investigated so that adequate control measures may be instituted

Drought relief sanitarians in 39 counties did some screening and are carrying on rather thorough educational programs

There are eighteen towns in Texas that have full time mosquito control inspectors or supervisors 32 towns that have part time men Three towns inaugurated control programs this year In a number of the smaller places where work had lagged on account of lack of supervision it was revived and systematic programs were carried out It is estimated the total budgets for malaria control by cities and towns in 1931 amounted to $75 000 00

In 1930 a total of 8 958 cases of malaria were reported to the State Department of Health Up to October 1 1931 a total of 5 955 cases were reported Two hundred twenty seven deaths from malaria were reported in 1930

It is worthy of note that the City of Dallas is using unemployment funds to straighten creek channels and for ditching and oiling The City of Texarkana likewise used a portion of the Will Rogers charity fund for drainage work

With five counties in Texas carrying on active malaria control demonstration programs with nineteen drought relief sanitarians stressing educational work and with thousands of school children knowing the true cause of malaria and how to prevent it we are optimistic in our belief that the next few years will see a malaria enlightened state

Dr Francisco Banda (Consul General of Ecuador), New Orleans La—I believe that on this occasion when we discuss malaria control and the means of preventing malaria credit should be given to the country which gave to the world the medicine to cure malaria that is the cinchona bark commonly known as Peruvian bark, which in justice to the country which gave to humanity this alkaloid should be called Ecuadorean bark since it was first discovered in Ecuador

The earliest well authenticated instance of the medicinal use of the cinchona bark is found in the year 1638 when the Countess of Chinchon (hence the name) the wife of the Governor of Peru was cured of an attack of fever by its administration The medicine was sent and recommended in her case by the Corregidor of Loja a province in southern Ecuador on the Peruvian frontier and was taken from the barks of trees indigenous to this region and after its curative qualities had been practically experienced by the Corregidor himself eight years earlier A knowledge of the properties of the curative bark was disseminated throughout Europe by members of the Jesuit brotherhood Hence it also became generally known as Jesuit's bark According to another account this name rose from its value having been first discovered to a Jesuit doing missionary work in Ecuador who being prostrated with fever was cured by the administration of an extract from the cinchona bark given to him by an Ecuadorean Indian Later the English scientists Spruce Markham and Cross, transplanted cinchona trees from this region to India and started there the scientific cultivation of this valuable tree

The same thing is true of the potato It is called Irish potato but it came first from Ecuador Also the so called Panama hats " Most and finest are made in Ecuador yet they are called Panamas" Rubber also was first discovered in my country by La Condamine I want you to tell the world that Ecuador gave to the world the cinchona bark.

Mr LePrince Memphis Tenn—I have walked many many miles while in Panama looking for the place where the Panama hat is made and could not find it

Dr C P Coogle Memphis Tenn—Mr Stanley's appearance in this body of malaria field workers is of enormous interest to us principally because he is one of the South's leading professional salesmen

Salesmanship is a subject that this assembly of public health workers continually collides with We are not different from other groups of human beings in many respects It is easy for us to see the layman's fault in its attempt at self medication to cure malaria It must be amusing to Mr Stanley and other professional salesmen to see our self styled self created self patterned and self taught practices of salesmanship

Salesmanship is one of the fine arts The fundamental principles of salesmanship are as important as are the fundamental principles for the sculptor or the artist or the musician or any of the geniuses The natural born but untrained salesman is as far from being a professional salesman as a crude strong bodied man is

prepared to engage in professional athletics with only the knowledge of the games he acquired in amateur play

I sincerely believe professional salesmanship is a subject of major importance to our success and I am suggesting to Mr Stanley that he discuss with us during the closing of this fine paper the following five questions

(1) How can we become better salesmen in our field of work and finally master salesmen?

(2) Would you define for us the terms customers and prospective customers in so far as these terms would apply to the general public living in a rural area in which one of us would like to engage in malaria control work?

(3) Will you briefly discuss sales cost as it applies to popularizing malaria control work in both rural and urban areas?

(4) Also discuss for us personal inventory as it applies to the salesmanship of public health?

(5) What are the principal objectives in advertising or propaganda as we choose to call it?

Mr Stanley (closing) —With your permission I shall discuss the five very important questions just raised by Dr Coogle

As a layman vitally interested in the wider development of public health work I have long felt that some way should be found to sell in a package acceptable to the public at large this very interesting and worthwhile commodity we call public health I would not dare question the scientific facts we have heard here but I sometimes feel like questioning the manner in which they are given to the public

(1) In selling we must first know to whom we are going to sell a given commodity We must survey carefully their background their earning power their cultural background, their needs and the manner in which they are accustomed to buying This briefly is a study of the market in which we sell In my State for example we have at least five different backgrounds or sounding boards against which we must throw our sales message For example the sawmill community of East Texas will differ from the community in the next county that specializes in growing truck crops while the black land farmer in the heavy cotton producing belt is still another type Out on the plains we have the dry land farmer who cultivates his crops with a tractor lives in a big house has a barn twice the size of his house Down in the Big Bend country we have the large cattle ranches with a real flavor of the old West where men ride hard and shoot fast On the Mexican border we meet our neighbors from across the Rio Grande with a dash and beauty of the charm of Old Spain To succeed then in selling a malaria control program to Texas we must know the people to whom we are speaking

Our commodity or product which in the present instance is Freedom from the most impoverishing disease known" has a quality for which we need never make an excuse

It then becomes our task to put the commodity in a package that will be acceptable to the market in which we expect to sell Some sections of the country *want a bright colored package others are content* with less Some are frankly more interested in quality and full measure than in package Mr LePrince whose busy life has carried him through the Americas will I am sure agree that the sale appeal that will sell malaria control in one section of the country will not work in another section One man may find that the relief from chills is the important thing for him Another may be willing to bear any burden if we can bring back the sparkle of youth and vitality to his child. The business man is interested in the saving of dollars and the building of his business enterprise

(2) It is my conviction that all public health work should be tax supported. Hence the first prospective customer we have to deal with Dr Coogle is the taxpayer Straining as we are under the burden of ever increasing taxation to say merely that it should be tax supported and let it stand there is to spell its doom. In an effort to secure the modest appropriation before mentioned for work now under way in Texas we appealed to the heaviest taxpayers in the State on the appeal that all preventable illness, and malaria in particular was costing us annually millions of dollars, and that the way to lift this yoke of tax oppression was to spend a few thousand dollars to remove the cause of the heavy tax The difference between $50 000 for control work and $50 000,000 for neglect was so obvious that letters from no less than 200 of the outstanding business and professional men of the State were filed with the Legislature then the request for the appropriation was made In my opinion they were the balance of power that secured the money

The immediate customer for our commodity is the malarial sufferer who it seems to me should be the easiest of all to sell on the need of protection I am unwilling to believe that anyone wants to be sick *A life of freedom from disease a life abundant with all* the joy of living should then be the appeal to reach the farmer whose home should be screened

In antebellum days the farm home of the South was the seat of culture refinement and the joy of life Our Nation was cradled in a rural atmosphere our leaders sought the beauty and charm of the rural life Today the picture has been reversed. The average farm today is about the most undesirable place to live Without protection afforded by science in a pure water supply a screened home free from deadly flies and mosquitoes and with an ever embarrassing open toilet the boys and girls of the farm leave it at the first chance It is up to us gentlemen to bring back the glory that was once the pride of the rural homes It is a challenge that will fire the blood of every Southerner

(3) In budgeting our sales cost we base the percentage upon the number of units sold For example on a fixed cost, the more we sell the less per unit it costs us The same *theory will hold in applying the* program of public health work. For example in my home town we spend let us say $10,000 on mosquito control. We have a population of 300,000 which re

duces the expense, or the cost per person to the small sum of 3 1/3 cents per capita per year In another community of 8 000 the sum of $800 00 per year is spent raising the cost per capita to 10 cents

If the Malaria Unit working in East Texas at the present time pending $25 000 annually did no more than popularize malaria control work through their educational campaign reaching 2 500,000 people it would be worth many times the 1 cent per capita cost

(4) In the matter of the personal inventory this as in any other phase of selling will apply to the salesman " There are two things that I would like to stress in this connection first, the mental development of the salesman It has been said that 5 per cent of the American people do all our thinking that 10 per cent copy what the five thought and that 85 per cent have never had an original idea If this be true and it no doubt is true it is clearly our job to do the thinking for our prospects leading them through the process of selling themselves The second phase of the personal inventory is the health and vigor of the salesman I think that every public health worker should be a walking advertisement for the commodity he sells practising everything he teaches even to the doctor taking a little of his own bitter pills now and then

(5) In selling and advertising we are playing upon the keyboard of human emotions The best definition of salesmanship and advertising that I have ever found is Arousing the emotions of the prospect and causing his will to act or buy In days gone by we sold things. But people do not buy things today they buy effects In malaria control we do not sell screen doors or quinine we sell health vigor, and freedom from disease

I am firmly convinced that malaria control is as much of a problem for commercial interests to consider as it is for sanitarians to consider and feel sure our visitors from the southern republics will agree with me The commercial interests with which I am associated feel that the proper way to proceed is to develop a wider demand here in our country for the products of the republics represented here today

SYMPOSIUM ON MALARIA, Part 3*

MALARIA CONTROL IN ALABAMA 1931*

By J N BAKER M D †
Montgomery Ala

When I assumed the duties of State Health Officer of Alabama in 1930 the malaria problem was brought forcefully to my attention by the increase in death rates from malaria in the State during the two preceding seasons In order to establish a working basis to attack this problem our central staff was requested to prepare an analytical report and I herewith desire to present some of its salient features Later detailed discussion of methods and results will be given I quote from the report made by the staff at this time

In considering the subject of malaria control it must be recognized

(1) That the disease is confined to certain endemic areas

(2) That the areas of ***Anopheles quadrimaculatus*** production vary from pools or pot holes of temporary or permanent nature to lakes and swamps of many square miles extent

(3) That these areas are not distributed regularly or uniformly over the State or even over a county

(4) That certain counties contain more breeding areas than others

(5) That the extent and character of breeding may *vary from year to year*

(6) That the power and length of the transmission season vary from year to year

Also it must be further recognized

(1) That the only positive control measure is the elimination of the vector and that drainage which dries up the breeding area is necessary for complete effectiveness

In considering this measure it should be understood that these areas or lands are privately owned by one or many persons, with conceivably varying interests that *the actual cost of* drainage must *be borne* by these property owners and that normally there are no state funds which can be used to aid Hence these areas cannot be drained until the property owner or owners see fit To attempt to use any medico legal means would entangle the health forces in economic problems beyond the control even of the land owners

It must be conceded however that minor drainage can be accomplished from time to time through education and economic need Major drainage can be accomplished at the owners desire through legal machinery now set up for that purpose Many areas cannot be drained at all without expenditure of funds entirely beyond the resources of the owner of the land affected

(2) Where positive drainage cannot be affected the suppression of the Anopheles by larvicidal measures can be considered Here again the cost of this must be borne largely by the landowner or by the population group affected Many areas can be controlled at a cost which will be justified by results Other areas cannot be so controlled Legal compulsion would not be warranted except in extreme cases such as impounding of waters for gain or pleasure

(3) *Where control* through these primary measures cannot be accomplished secondary measures may be used in the form of screening house spraying drugs and natural enemies This cost also must be borne largely by the landowner or those affected Drugs have been dispensed through state county and private funds in a few instances where the disease was epidemic in a limited area

Again legal compulsion would not be warranted in either drug administration or house screening

The Committee recognizes these methods as effective in the order presented but wherever circumstances warrant they should be combined

Having thus roughly outlined the problem it now seems necessary to consider *what has been or can be* done The possibilities appear to be as follows

(1) A general statistical study has already determined those counties where the disease is a major problem These counties fall into two classes

(a) Those with health units and

(b) Those without health units

(2) Further statistical studies now under way of the counties with high rates will indicate the relative importance of malaria compared to other diseases subject to control

(3) Counties having health units of a year or more duration should be able to indicate the general location of malaria foci within said counties

(4) Where such information is not available as in the unorganized counties an approximation can be had through case histories.

(5) Where general endemic areas have been located detailed field surveys with recommendations of methods adjudged feasible to reduce or control the disease can be made if such surveys have not already been made

(6) The reduction is largely dependent upon education and persuasive measures There is no direct remedy which the health forces can apply independently through their own finances or volition The use of natural enemies of the Anopheles is excepted.

It is recognized that much can be done through such educational measures and that these are necessary and may accomplish no little results In certain instances endemic areas can be eliminated and in others

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Fifth Annual Meeting New Orleans Louisiana November 18-20 1931

†Health Officer State of Alabama

Part 3 of a Symposium on Malaria comprising principally papers, discussions and reports before the National Malaria Committee Part 1 was published in the *Southern Medical Journal* for May and Part 2 in the *Southern Medical Journal* for June Part 3 appears only in this reprint

controlled by one or more of the general methods applicable

As in all health work personnel and equipment are required In antimalaria work it is difficult to predict accomplishment since results depend almost entirely upon persuasive measures Malaria recedes through progress or civilizing of the area Its control or elimination goes hand in hand with agricultural and structural development In this the health forces play a part but hardly the major role

"In the light of these possibilities it is recommended

(1) That statistical studies of malaria morbidity or mortality be made or continued by the central office

(2) That a conference between the central staff and the county health officers of organized counties found to have a major malaria problem be held to discuss a program for control in each county

(3) That when it is agreed that malaria control is a major problem of any county health department ways and means to provide local personnel to carry on an antimalaria program be worked out

(4) That state personnel to aid in an analysis of local problems be provided if not now available and that State personnel aid for actual application in training or performance be provided if found necessary

(5) That the counties without health units be considered in the light of affecting State rates and the desirability of providing State service which should be considered as a demonstration In connection with this recommendation attention is called to the appropriation made by the Legislature for demonstration purposes

(6) In the light of the fact that recent work has indicated the value of certain drugs in the control of malaria it is recommended that one of several typical areas be selected and worked by trained county or state personnel to determine the practical value of drugs in secondary control

Using this report as a basis of activities in Alabama, each will be briefly described by headings

(1) *Statistical Study*—A statistical study revealed that there were twenty five counties with an average annual malaria death rate above 10 per 100 000 population for the period 1926 1928 Twenty two of these had county health units while eleven had county sanitary officers

The comparative morbidity reports for the State as a whole for the years 1926 1931 from January 1 to November 1 of each year are given herewith The period is too short to represent a trend but indicates relative conditions The statistics are as follows

Year	No Cases Malaria Reported
1931	2219
1930	4397
1929	9496
1928	5808
1927	3417
1926	2290

(2) *Conference Between Central Staff and County Health Officers*—Shortly after the Committee report was prepared a conference was held between the central staff and a number of the health officers from counties having a major malaria problem In working out a program visits to neighboring states were made and conferences were held with representatives from both state and national health organizations

The initial program in Colbert County was extended to the counties of Houston Clarke Lamar Perry Monroe Escambia Macon and Geneva A trained worker supplied with motion picture equipment and tools was detailed to the health officer in each of these nine counties An engineer from the central office was also detailed to these counties to aid in the initiation of the program which was modeled somewhat after work being done in other Southern states Special emphasis was placed on education drainage and the mosquito proofing of houses The method used in the latter phase of the work was that advocated by the United States Public Health Service

Publicity was given the work through newspaper articles posters and a on Malaria control committees were formed in several counties and functioned by means of letters and other information directed to various citizens in the county Suitable transportation arrangements were provided. Quotations on screen doors, screen wire lumber paper and other materials were received Malaria surveys were begun in a majority of these counties with orders for screening being taken as the work progressed The proposition made to the property owners was that the county would furnish transportation of materials provide tools and supervise the work while the occupant of the house was to furnish the labor and the owner to furnish material which could be purchased at practically wholesale prices We have found that this proposition appeals to the owner if he is the least interested in screening No attempt has been made to obtain a revolving fund for extending credit The conclusion was reached that if a man s credit was good the merchants would be willing to carry him and if it were not a revolving fund should not be expected to do so

The motion picture how is being used extensively in the work We have standardized on 16 millimeter equipment and have supplemented the I.H B film on Malaria with two of our own one on Screening and the other on Drainage " These films are scheduled for showing at each meeting Special importance i attached to the educational work as it is felt that it hastens the time when people will screen their homes without help from outside sources

(3) *Detail of State Personnel on Local Problems and for Training County Personnel*—Engineers were detailed temporarily to the counties of Montgomery Dallas and Limestone for the purpose of initiating malaria control programs Inasmuch as these counties had sanitary officers it was possible for the programs to be carried on after the engineers from the central office were recalled

Special trainin has been given county personnel at our field training station In add tion a school for county sanitary officers was held this year where de ta led training on malaria control was given

We continue to lay pecial empha is on drainage though economic conditions are preventing very much actual construction Many prelim nary surveys have been made Plans profiles and estimates of cost were prepared and submitted to those persons directly in tere ted Here and there a small project is drained A $45 000 00 project in Montgomery County was com pleted during July the fruits of wh ch are already to be seen

The following tabulation gives data on rural drain age for the past year in thirty five of our sixty seven counties

- [illegible] projects surveyed for drainage
- 65 projects drained
- 27 miles of ditch dug
- 1530 acres in projects drained
- 666 persons interviewed for drainage

The following tabulation g ves data on rural malaria control (exclusive of drainage) for the pa t year in thirty five of our sixty seven cou t es the bulk of which work has been done in twel e of the most mala *rious count es*

- 1300 square miles of territory covered by malaria survey
- 5900 famil es covered by malaria survey
- 1970 houses measured for mosquito proofing
- 687 houses screened
- 9260 persons interviewed for mosqu to proof ng
- 270 p cture shows g ven in the interest of malaria control

The number of hou [illegible] screened is seemingly small A significant fact *is that 7.5 per cent of the persons in* terviewed [illegible] an order for screen ng There s no denying the fact that the low [illegible] ce of all farm prod ucts has materially slowed down our screening efforts When cond tions mp ove we hope for more extensive screening and also for an expans on of rural san ta tion

(4) *Work n Unorgani ed Co nties*—Except for oc casional visits following requests for advice on local p oblems no work on malaria or mosquito control has been done in count es not having a health un t

(5) *Plasmochin Experiments*—During the season of 1930 and 1931 experime ts were carried out to deter mine if possible the value of plasmoch n in the pre vention of malaria The general plan of the experi ments was to admi ister plasmochin at regular intervals to [illegible] the people l ving n a certain a ea and to observe the effect on the ncidence of malaria du ing the sea son a similar area to be used for control

In the first year (1930) such an experiment was carried out in two counties [illegible] the State each area em bracing approximately five hund ed people The plan of operation included an original blood survey together w th the history of previo malaria This w s [illegible] lowed by the administrat on of plasmoch n compound tablets (each containing 0 01 gms plasmoch n and 0 125 gms quinine sulphate) at weekly intervals [illegible] the dem onstration groups The clinical cases of malaria occur ring in both demonstration and control groups were carefully recorded and a second blood survey was made at the end of the work

The plan followed the second year (1931) was simi lar to the preceding year with certain changes

(1) One large area of approximately 31 square miles containing a population of about 1 100 wa used for the demonstration A sim lar area near by was used for control

(2) The dosage of plasmochin was increased to one tablet twice a week

(3) Mo quito catching stations were set up in each area *to prove the presence of Anopheles quadrimacu latus*

The e was a marked reduction n malaria in all areas n both these years but the reduction was much more marked amongst those receiving pla mochin Mosquito catches showed more *Anopheles quad imaculatus* in the demonstration area so this increased reduction was not due to lack of vectors The blood surveys d d not record any particular difference in the two areas either year

F om this it would appear that pla mochin com pound in dosage of 2 tablets per week (each tablet containin 0 01 gms plasmochin and 0 125 gm quinine sulphate) when administered to all the inhabitants of a district will materially lessen the incidence of malaria

Gene al—Control of impounded water on a State wide ba is rema ns one of our major activities The Bureau of En ineering directs the wo k w th the county health units cooperating While no large hydroelectric *projects have been impounded this year a number of* small lakes were constructed Weekly reports of in spections and control operations are submitted on the larger p ojects The work [illegible] done by company em ployes Since the regulations went into effect in 1923 a total of 114 perm ts for impounding have been issued.

Minor epidemics of malaria developed around three relatively small projects during 1930 One resulted through impoundage of an old pond without proper clean g another th ough raising the water level of a properly p epared pond flooding an uncleared area and the other through inadequate control of an old pond The condit ons were discovered too late to pre vent the occurrence of malaria transmission Adequate cont ol measures during the season of 1931 prevented *Anopheles quadrimaculatus* production and further trans mission

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(5) That the counties without health units be considered in the light of affecting State rates and the desirability of providing State service which should be considered as a demonstration. In connection with this recommendation attention is called to the appropriation made by the Legislature for demonstration purposes.

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Publicity was given the work through newspaper articles, posters, and so on. Malaria control committees were formed in several counties and functioned by means of letters and other information directed to various citizens in the county. Suitable transportation arrangements were provided. Quotations on screen doors, screen wire lumber paper and other materials were received. Malaria surveys were begun in a majority of these counties with orders for screening being taken as the work progressed. The proposition made to the property owners was that the county would furnish transportation of materials provide tools and supervise the work while the occupant of the house was to furnish the labor and the owner to furnish material which could be purchased at practically wholesale price. We have found that this proposition appeals to the owner if he is the least interested in screening. No attempt has been made to obtain a revolving fund for extending credit. The conclusion was reached that if a man's credit was good the merchants would be willing to carry him and if it were not a revolving fund should not be expected to do so.

The motion picture show is being used extensively in the work. We have standardized on 16 millimeter equipment and have supplemented the I H B film on Malaria with two of our own one on Screening and the other on Drainage. These films are scheduled for showing at each meeting. Special importance is attached to the educational work as it is felt that it hastens the time when people will screen their homes without help from outside sources.

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In the first year (1930) such an experiment was carried out in two counties in the State, each area embracing approximately five hundred people. The plan of operation included an original blood survey together with the history of previous malaria. This was followed by the administration of plasmochin compound tablets (each containing 0.01 gms plasmochin and 0.125 gms quinine sulphate) at weekly intervals to the demonstration groups. The clinical cases of malaria occurring in both demonstration and control groups were carefully recorded and a second blood survey was made at the end of the work.

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(3) Mosquito catching stations were set up in each area to prove the presence of *Anopheles quadrimaculatus*.

There was a marked reduction in malaria in all areas in both these years but the reduction was much more marked amongst those receiving plasmochin. Mosquito catches showed more *Anopheles quadrimaculatus* in the demonstration area, so this increased reduction was not due to lack of vectors. The blood surveys did not record any particular difference in the two areas either year.

From this it would appear that plasmochin compound in dosage of 2 tablets per week (each tablet containing 0.01 gms plasmochin and 0.125 gms quinine sulphate) when administered to all the inhabitants of a district will materially lessen the incidence of malaria.

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Using this report as a basis of activities in Alabama, each will be briefly described by headings

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Publicity was given the work through newspaper articles, posters, and so on Malaria control committees were formed in several counties and functioned by means of letters and other information directed to various citizens in the county Suitable transportation arrangements were provided Quotations on screen doors, screen wire lumber paper and other materials were received Malaria surveys were begun in a majority of these counties with orders for screening being taken as the work progressed The proposition made to the property owners was that the county would furnish transportation of materials provide tools, and supervise the work while the occupant of the house was to furnish the labor and the owner to furnish material which could be purchased at practically wholesale prices We have found that this proposition appeals to the owner if he is the least interested in screening No attempt has been made to obtain a revolving fund for extending credit The conclusion was reached that if a man's credit was good the merchants would be willing to carry him and if it were not a revolving fund should not be expected to do so

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The number of houses screened is seemingly small. A significant fact is that 75 per cent of the persons interviewed gave an order for screening. There is no denying the fact that the low price of all farm products has materially slowed down our screening efforts. When conditions improve we hope for more extensive screening and also for an expansion of rural sanitation.

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always produced the desired results. Favorable water level fluctuation and elevations this year have effected a complete control without the use of any larvicide or shoreline cleaning. Not one half dozen adult *Anopheles quadrimaculatus* mosquitoes have been observed through weekly inspection of the more than thirty catching stations bordering the lakes.

Just the reverse occurred on a seven year old major project in the northern part of the State which was cleared prior to impoundage. Larvicide and cleaning have been employed on this project each season since its impoundage. Favorable water level schedule during the season of 1930 produced a fairly satisfactory control as the average *Anopheles quadrimaculatus* mosquito station catch was less than two. A less favorable water level schedule has prevailed this season and the average station catch rose to eight.

Some idea as to the average life of *A. quadrimaculatus* mosquitoes in nature has been afforded by an observation on a small pond in the eastern part of the State. The project was cleared prior to impoundage four years ago. Fluctuation is not feasible due to the small inflow and the use to which the pond is put. The first inspection during midsummer revealed sixty *A. quadrimaculatus* per station. Thorough oiling at weekly intervals was begun at once. Within three weeks the station count was reduced to zero where it remained until the end of the season.

While malaria transmission can no longer be considered an urban problem in Alabama, our field workers are devoting some time to general mosquito control in towns and cities as local pressure demands. Much old drainage is being maintained and new work extended to suburban areas. The work consists largely of advice to municipal officials, though in some cases routine supervision is given. In some places the work inaugurated years ago is being carried on effectively without any expenditure of time on our part.

The following table gives the data on municipal mosquito control work for the past year in forty counties:

84 cities or towns doing work
463,300 people affected
23 miles new ditch dug
150 miles old ditch cleaned
32,900 gallons of oil used
3,900 gallons of commercial larvicide used
15,000 gambusia distributed
$44,970.00 estimated cost of work

In closing, I should like to state that a special emphasis is being placed on educational work. The press, the radio, the motion picture show, the training school, and our personnel are all utilized in getting the facts before the people. The new 16 millimeter motion picture equipment including five reels on malaria control is being used in fourteen counties and to date approximately 10,000 people have been reached through this means.

The training of county personnel is unquestionably of great importance. As these men become interested and master the technic and knowledge of malaria control the volume of work done will surely rise and it will then truly become an activity of the county unit. The technical knowledge of the central staff may then be put to work in the field where it rightfully belongs. Malaria control is a diversified problem and much training is necessary to develop a field man who can intelligently meet all phases of this complex question.

MALARIA CONTROL ACTIVITIES IN ARKANSAS DURING 1931*

By C. W. GARRISON, M.D.,†
Little Rock, Ark.

Malaria control activities in Arkansas during the 1931 season have consisted of work in urban areas together with an increase in activities in rural areas through mosquito proofing of homes and the administration of quinine.

Twenty-six urban areas having populations from 1,500 to 82,000, with a total population of 190,608, were treated by means of the customary oiling, draining and inspection operations. This number includes 24 cities and towns previously doing work, together with two new cities.

Considerable difficulty was experienced in raising adequate funds locally to carry on the work as was desired, but personnel was made available through the various relief agencies engaged in assisting the unemployed. Very effective measures were carried out in the matter of clearing and cleaning drainage ditches and impounded areas, and clean-up campaigns were inaugurated and successfully completed in practically all towns. Satisfactory control was obtained until the early part of September when there was a very sudden and noticeable increase in mosquito prevalence.

There were no breeding places within the control area and the history of each case was fairly uniform in that the flight was reflected in all sections of the town simultaneously.

The suddenness of these flights has raised a number of questions, particularly at those points where they seemed to have come from a considerable distance. The flights included both the Anopheles and Culex types, and it seems likely that temperature conditions might have had something to do with the sudden invasion of the urban areas where a slightly higher temperature prevails.

Activities in the rural areas were carried on by county health unit personnel and at the time of writing this memorandum 600 rural homes had been mosquito proofed in 19 counties. Consideration was given to the establishment of screen door factories at certain

*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 16-20, 1931.

†State Health Office.

centrally located points but it was found impossible to finance such projects at this time. Results obtained have been accomplished by personal contact with the property owner and cost data was not kept. The State Board of Health also dispensed to the county health organizations 500,000 grains of quinine which had been obtained through the Drouth Relief aid. This quinine was used to treat acute indigent cases.

The total number of malaria deaths reported for 1930 was 683 as compared to 667 for 1929 and 876 for 1928.

MALARIA CONTROL WORK IN FLORIDA*

By HENRY HANSON, M.D.†
Jacksonville, Fla.

Malaria control work in Florida has continued as in past years except for certain important additions such as the establishment of the Malaria Research Division of the State Board of Health, Rockefeller Foundation cooperating, and a station for the study of mosquitoes and other biting insects by the Bureau of Entomology of the Department of Agriculture.

The municipalities, especially the larger ones, carry on active antimosquito measures consisting mainly of construction and maintenance of drainage ditches. As a result of this work Anopheles mosquitoes in the large cities are extremely rare.

The State Board of Health continues advocating screening of all homes as the most practical and immediately effective means of protection against an attack of the disease.

The United States Public Health Service has continued its supervision and study of Anopheles breeding in the impounded water areas.

Mosquito and Anopheles surveys were made in Pinellas County and about the City of Gainesville in Alachua County, which resulted in establishment of drainage activities and other control measures with gratifying results.

Mr. Bradley of the Bureau of Entomology assisted the Bureau of Engineering with a survey of Anopheles breeding conditions in the vicinity of Belle Glade, Palm Beach County. Recent years have shown a tendency to an increase of malaria in the southern portion of the State where previously there had not been so high an incidence of mortality reports.

The full time county health units in Taylor and Leon Counties have carried on an active program of screening and some quinine distribution.

Reports of county health officers are attached.

The lessened rainfall for the last two years has greatly modified the appearance of the mortality reports from our Bureau of Vital Statistics. There is attached a malaria spot map for the first nine months of the year 1931. This shows 135 malaria deaths for this year. For the same period in 1930 there were 243 deaths and in 1929, which was our last peak year, there were 318 deaths reported for the corresponding nine months of the year.

During the early months of the year the Malaria Research Division under the direction of Dr. Mark F. Boyd made a spleen survey of the counties between and some adjacent to the Suwanee and Appalachicola Rivers, the findings of which indicated this area as the one having the greatest incidence of malaria.

A series of radio talks was given over the radio station at Gainesville on malaria and mosquito control.

The Florida Antimosquito Association has continued its annual meetings and has had nationally known authorities on the program who have contributed valuable information to the malaria control activities.

In addition to activities mentioned above, surveys have been made in Jackson, St. Lucie, Seminole, Broward and Sarasota Counties.

Summary of the Antimalaria Activities of the Taylor County Health Unit from June 1, 1930 to November 1, 1931 by Dr. W. H. Y. Smith, Director, Taylor County, Florida, Health Unit

Dusting with Paris green and lime was done in four places and clinics for the distribution of quinine (for those who were unable to pay for the drug) have been held in seventeen places throughout the County, each clinic being held on the same day and at the same hour of each week. These clinics were discontinued in the latter part of August 1931 because of lack of quinine. One thousand and ninety seven individuals were given quinine and 66,141 five grain capsules of quinine were distributed.

Two ponds were stocked with gambusia in an attempt to make a reservoir for stocking ponds and ditches throughout the County.

A large quantity of literature was distributed and numerous newspaper articles were given out about malaria and its prevention. The sanitary officer advised screening of homes and sleeping porches and dusting with Paris green whenever possible.

Thirty two homes were effectively screened against mosquitoes and flies.

Summary of the Antimalaria Activities of the Leon County, Florida, Health Unit by Dr. L. J. Graves, Director

Since June 30 our malaria work has been about as follows:

The ponds and lakes along the Jackson Bluff Road were dusted regularly with Paris green until the water dried up.

In and near Tallahassee dusting and oiling were carried on systematically during the summer and fall. Two men with a truck and home light generator did this work. One regular inspector and one and two as-

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*Read before the National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 18-20, 1931.

†State Health Officer.

always produced the desired results. Favorable water level fluctuation and elevations this year have effected a complete control without the use of any larvicide or shoreline cleaning. Not one half dozen adult *Anopheles quadrimaculatus* mosquitoes have been observed through weekly inspection of the more than thirty catching stations bordering the lakes.

Just the reverse occurred on a seven year old major project in the northern part of the State which was cleared prior to impoundage. Larvicide and cleaning have been employed on this project each season since its impoundage. Favorable water level schedule during the season of 1930 produced a fairly satisfactory control, as the average *Anopheles quadrimaculatus* mosquito station catch was less than two. A less favorable water level schedule has prevailed this season and the average station catch rose to eight.

Some idea as to the average life of *A. quadrimaculatus* mosquitoes in nature has been afforded by an observation on a small pond in the eastern part of the State. The project was cleared prior to impoundage four years ago. Fluctuation is not feasible due to the small inflow and the use to which the pond is put. The first inspection during midsummer revealed sixty *A. quadrimaculatus* per station. Thorough oiling at weekly intervals was begun at once. Within three weeks the station count was reduced to zero where it remained until the end of the season.

While malaria transmission can no longer be considered an urban problem in Alabama, our field workers are devoting some time to general mosquito control in towns and cities as local pressure demands. Much old drainage is being maintained and new work extended to suburban areas. The work consists largely of advice to municipal officials, though in some cases routine supervision is given. In some places the work inaugurated years ago is being carried on effectively without any expenditure of time on our part.

The following table gives the data on municipal mosquito control work for the past year in forty counties:

84 cities or towns doing work
463,300 people affected
[illegible] miles new ditch dug
150 miles old ditch cleaned
32,900 gallons of oil used
5,900 gallons of commercial larvicide used
15,000 gambusia distributed
$44,970.00=estimated cost of work

In closing I should like to state that a special emphasis is being placed on educational work. The press, the radio, the motion picture show, the training school and our personnel are all utilized in getting the facts before the people. The new 16 millimeter motion picture equipment including five reels on malaria control is being used in fourteen counties, and to date approximately 10,000 people have been reached through this means.

The training of county personnel is unquestionably of great importance. As these men become interested and master the technic and knowledge of malaria control the volume of work done will surely rise and it will then truly become an activity of the county unit. The technical knowledge of the central staff may then be put to work in the field, where it rightfully belongs. Malaria control is a diversified problem and much training is necessary to develop a field man who can intelligently meet all phases of this complex question.

MALARIA CONTROL ACTIVITIES IN ARKANSAS DURING 1931*

By C. W. Garrison, M.D.,†
Little Rock, Ark.

Malaria control activities in Arkansas during the 1931 season have consisted of work in urban areas together with an increase in activities in rural areas through mosquito proofing of homes and the administration of quinine.

Twenty six urban areas having populations from 1,500 to 82,000 with a total population of 190,608 were treated by means of the customary oiling, draining and inspection operations. This number includes 24 cities and towns previously doing work together with two new cities.

Considerable difficulty was experienced in raising adequate funds locally to carry on the work as was desired, but personnel was made available through the various relief agencies engaged in assisting the unemployed. Very effective measures were carried out in the matter of clearing and cleaning drainage ditches and impounded areas, and clean-up campaigns were inaugurated and successfully completed in practically all towns. Satisfactory control was obtained until the early part of September when there was a very sudden and noticeable increase in mosquito prevalence.

There were no breeding places within the control area and the history of each case was fairly uniform in that the flight was reflected in all sections of the town simultaneously.

The suddenness of these flights has raised a number of questions, particularly at those points where they seemed to have come from a considerable distance. The flights included both the Anopheles and Culex types and it seems likely that temperature conditions might have had something to do with the sudden invasion of the urban areas where a slightly higher temperature prevails.

Activities in the rural areas were carried on by county health unit personnel and at the time of writing this memorandum 600 rural homes had been mosquito proofed in 19 counties. Consideration was given to the establishment of screen door factories at certain

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†State Health Officer.

GEORGIA MALARIA CONTROL 1931*

By L. M. Clarkson †
Atlanta, Ga.

The malaria problem in Georgia is subject to considerable fluctuation due to excesses and deficiencies of annual precipitation. A record which has been maintained for the period of 1921 to 1931 shows without exception a corresponding increase or decrease in deaths according to excess or deficiency of rainfall. Consequently death rates also show an increase or decrease consistently with rainfall fluctuation.

Malaria mortality reduction may be shown over a three year period, namely 1929 to 1931. These years are comparable to October 1 only, since 1931 mortality records are only available to October 1. The comparison is as follows: 1929, 401 deaths; 1930, 300 deaths; 1931, 186 deaths. The death rate per 100,000 decrease from 1929 to 1931 is 53.5 per cent. Such figures show a very decided reduction of the malaria problem over a three year period. We must consider that there was an exceptionally heavy rainfall in 1929 followed by a decided deficiency for the past two years. However, we feel confident that extensive and intensive drainage application for over a year for rural malaria control necessarily has had a definite effect upon the substantial reduction for the year 1931.

There are certain interesting phenomena connected with malaria geographical distribution in the two years past. Georgia is divided physiographically into two almost equal areas designated as the Piedmont Plateau and the Coastal Plain. Normally malaria is neither endemic nor epidemic in the Piedmont Plateau. The *A. quadrimaculatus* has previously been found only in preponderance in the Coastal Plain. Beginning with the year 1930 this species could be found generally throughout the Piedmont Plateau associated with malaria in epidemic occurrence. This condition has been more marked in 1931. This has resulted in malaria distribution as a state wide problem. This no doubt is due to an undisturbed biological condition for two excessively dry years with a reduction of velocity and run off of Piedmont Plateau waters. Consequently this portion of the State has now more nearly approached the biological characteristics of the Coastal Plain, thereby affording preferential conditions for propagation of *A. quadrimaculatus*.

The progress in malaria control during the past year has been exceptionally gratifying. It may be said that for the first time in the history of the State county officials are awake to the necessity for and to the value of the most tangible of all malaria control methods, namely drainage. It may seem paradoxical to state that the most arid period in the State's history has experienced the greatest sentiment for drainage. Georgia is certainly emerging from an economic depression, not from the national depression which is generally discussed today, but from an economic depression dating to the origin of the State, since which time industrial expansion has been retarded by malaria.

There are now twenty-two counties in the State using convict labor for county wide drainage. Six of these counties are also using machinery for this purpose. This plan is executed by the State Board of Health, which furnishes engineers for drainage surveys and limited supervision, while the counties furnish convicts. The work is being promoted as rapidly as the engineering personnel can render the service.

Mosquito control on hydroelectric impounded waters remains a very active item under malaria control. The rivers in the malarious section of the State are being developed for electric power, which necessitates the application of impounded water regulations to prevent malaria. The prestige of these regulations has stood the test and excellent cooperation is now extended by the power companies.

During the past year considerable engineering assistance was required in making malaria investigations and drainage surveys throughout drainage areas on rivers and creeks in the Piedmont Plateau. These have been acute problems due to retardation of normal stream flow caused by two years of drought. It is believed that with the resumption of normal rainfall most of these problems will be naturally eliminated.

Considering the malaria control program under present economic conditions, we feel optimistic and believe that the program will undoubtedly be accelerated under a more favorable economic period. Especially county drainage by convict labor has attained such momentum that it is hardly conceivable that it can now be impeded.

MALARIA CONTROL ACTIVITIES IN KENTUCKY*

By P. E. Blackerby, M.D. †
Louisville, Ky.

Briefly, there has been some progress in malaria control in Kentucky during the current year. Malaria has not been a serious problem in this State except in the counties bordering on or adjacent to the Mississippi River in the western section.

Special sanitary inspectors were assigned to this section of the State during the early summer months and a program of scree[illegible]g and mosquito proofing of homes

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†Director, Division of Sanitary Engineering, Georgia State Board of Health.

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sistants kept close check on all breeding places in the City making reports of all such places to the men with the truck.

About 12 000 five grain capsules of quinine have been distributed to indigent cases

During this time the inspectors estimate that [illegible] houses have been screened.

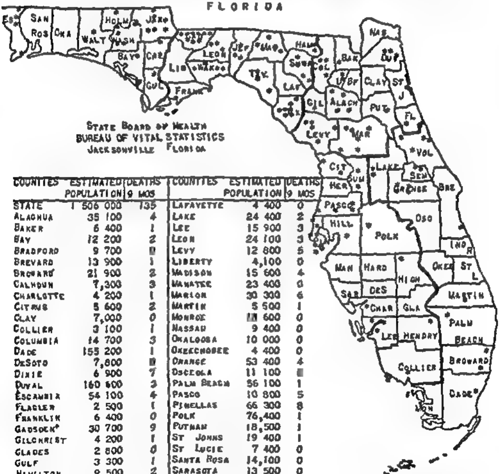
The prolonged drought has dried up so many of the ponds that malaria has not been so prevalent this year as formerly

THE FOLLOWING TABLE INDICATES THE NUMBER OF DEATHS FROM MALARIA BY MONTHS, FOR 1931 AS COMPARED WITH THE PREVIOUS YEAR PROVISIONAL FIGURES

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	TOTAL	OCT	NOV	DEC	TOTAL
1931	9	6	10	16	17	15	21	17	24	135				
1930	17	15	10	19	16	24	46	50	47	243	49	25	15	332
1929	24	7	13	24	30	58	83	89	70	318	[illegible]	39	29	458

MALARIA DEATHS BY COUNTIES FOR NINE MONTHS – 1931

FLORIDA



STATE BOARD OF HEALTH
BUREAU OF VITAL STATISTICS
JACKSONVILLE FLORIDA

COUNTIES	ESTIMATED POPULATION	DEATHS 9 MOS	COUNTIES	ESTIMATED POPULATION	DEATHS 9 MOS
STATE	1 506 000	135	LAFAYETTE	4 400	0
ALACHUA	35 100	4	LAKE	24 400	2
BAKER	6 400	1	LEE	15 900	3
BAY	12 200	2	LEON	24 100	3
BRADFORD	9 700	[illegible]	LEVY	12 800	5
BREVARD	13 900	1	LIBERTY	4,100	0
BROWARD	21 900	2	MADISON	15 600	4
CALHOUN	7,300	3	MANATEE	23 400	0
CHARLOTTE	4 200	1	MARION	30 300	6
CITRUS	5 600	2	MARTIN	5 500	1
CLAY	7,000	0	MONROE	[illegible] 600	0
COLLIER	3 100	1	NASSAU	9 400	0
COLUMBIA	14 700	3	OKALOOSA	10 000	0
DADE	155 200	1	OKEECHOBEE	4 400	0
DESOTO	7,800	[illegible]	ORANGE	53 400	4
DIXIE	6 900	7	OSCEOLA	11 100	[illegible]
DUVAL	160 600	3	PALM BEACH	56 100	1
ESCAMBIA	54 100	4	PASCO	10 800	5
FLAGLER	2 500	1	PINELLAS	66 300	8
FRANKLIN	6 400	0	POLK	76,400	1
GADSDEN*	30 700	9	PUTNAM	18,500	1
GILCHRIST	4 200	1	ST JOHNS	19 400	1
GLADES	2 800	0	ST LUCIE	7 400	0
GULF	3 300	1	SANTA ROSA	14,100	0
HAMILTON	9 500	2	SARASOTA	13 500	0
HARDEE	10 400	[illegible]	SEMINOLE	19,700	3
HENDRY	3 800	1	SUMTER	11,000	2
HERNANDO	5 000	0	SUWANNEE	15 700	4
HIGHLANDS	9,900	1	TAYLOR	13 400	3
HILLSBORO	161 500	1	UNION	7,700	2
HOLMES	12 900	1	VOLUSIA	45 100	4
IND RIVER	7 100	[illegible]	WAKULLA	5 500	4
JACKSON	32,100	6	WALTON	14 900	1
JEFFERSON	13,400	3	WASHINGTON	12,200	5

MALARIA NINE MONTHS BY AGES

AGES	DEATHS	AGES	DEATHS
-1	10	30–39	22
1– 4	15	40–49	14
5– 9	11	50–59	13
10–14	8	60+	24
15–19	8	UNK	1
20–29	9	TOTAL	135

LEGEND ONE DEATH
* STATE HOSPITAL INMATES INCLUDED

STEWART G THOMPSON
11–14–31 DIRECTOR

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†Director, Division of Sanitary Engineering, Georgia State Board of Health.

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†Director, Bureau of County Health Work, State Board of Health of Kentucky.

was begun. In preparation for the actual work surveys were made by these inspectors, in cooperation with the full time county health departments and the magnitude of the problem determined upon as a result of the survey. Economic conditions retarded to a considerable extent the progress of screening and mosquito proofing but even so somewhat widely separated demonstrations were made with very good results and a considerable community interest was aroused. In county seats and other incorporated towns considerable work was carried out in connection with draining and oiling of ponds and small streams. Group meetings of county health officers and sanitary inspectors were held in this section of the State and the problem of malaria control in all its phases in relation to public health were discussed. Posters and literature on malaria control were used extensively in many counties. This summarizes the activities carried out within the year.

MALARIA CONTROL IN LOUISIANA*

By W. T. BROWNE, M.D.†
New Orleans, La.

Up to October 1 this year the figures for house screening show a considerable increase over last year. The number of cases of malaria have decreased considerably through education and better drainage. With our miles and miles of new hard surfaced roads throughout this State with their drainage ditches on either side with the thorough education of the value of screening and with the help of the railroads in keeping their burrow pits in good shape we hope in another two years to be able to put malaria on the lowest level of communicable diseases.

NUMBER OF HOUSES SCREENED

1928	1929	1930	1931	Total
2101	1903	1883	1639	7526

To October 1

The death rate for malaria has also been considerably lowered. Up to the present the death rate is about 7.0 per 100,000 population.

We experimented with chinoplasm in a small community on about fifty cases of malaria. The patients have all recovered and in three months time have shown no return of the malady.

Chinoplasm has been advocated and experimented upon by the United Fruit Company in Honduras and also some of their other southern possessions with the greatest success.

Chinoplasm is a practically new drug containing a little quinine. It not only reduces the fever bringing the temperature to normal at about the sixth day but also kills both schizonts and gametes completely in peripheral circulation thereby making them non-infective to the mosquitoes.

In communities where malaria is prevalent chinoplasm should be used as a preventive. A tablet or two is given daily over a short period of time.

Screening and mosquito proofing of houses is now being carried on by about forty-five parishes in this State.

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†Director, Bureau Malaria Mosquito Control.

MALARIA CONTROL ACTIVITIES IN MISSOURI, 1931*

By W. SCOTT JOHNSON,†
Jefferson City, Mo.

Malaria constitutes a serious health problem in a limited number of counties situated in southeast Missouri and a potential menace in certain sections in the central part of the State situated in river bottoms or adjacent to large impounding reservoirs. The State program of malaria control during 1931 included cooperation with the full time county health units, owners of the largest hydroelectric project in the State situated in the central part of the State and supervision of the Federal financed malaria drought relief program in southeast Missouri.

The control work on the hydroelectric project, Lake of the Ozarks, was instigated at the request of the State Board of Health of Missouri. In 1925 Mr. J. A. LePrince of the United States Public Health Service and a representative of the State Board of Health made a survey along the portion of the Osage River that was to form the bottom of this lake to determine the prevalence of malaria and extent of Anopheles breeding. The results of this survey indicated that while malaria was generally present in this valley ten to fifteen years ago there had been practically no malaria cases during recent years. The survey further indicated that both *Anopheles punctipennis* and *Anopheles quadrimaculatus* were present throughout the valley in numbers sufficient to be of sanitary importance but that at the time of the survey they did not have access to malaria carriers. Approximately three-fourths of the farm homes in the area surveyed were fairly well screened which may have been materially responsible for the absence of malaria.

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From Division of Public Health Engineering and Sanitation, The State Board of Health of Missouri.

†Chief Public Health Engineer.

In view of these existing conditions the State Board of Health transmitted to the Union Electric Company owners of the project the following memorandum in the spring of 1931 before the dam had been closed

Malaria is a potential health problem in the Lake of the Ozarks region for the following reasons

(1) The malaria transmitting mosquito Anopheles abounds in sufficient numbers along the entire Lake

(2) The water area and shore line area have been greatly increased thus providing more ideal conditions for mosquito breeding

(3) The drift will be exceedingly heavy this summer making mosquito breeding conditions ideal

(4) Unfortunately the Lake is filling at the wrong time of the year which will probably make it impossible to keep the shore line clean by lake level control measures and to minimize mosquito breeding

(5) Many workmen and vacationists have visited and will continue to visit this area who are from the South and who are probably infected with the malaria parasite They will undoubtedly be bitten by Anopheles mosquitoes which in turn will become infected Thus malaria will be introduced into a territory which has been practically free of malaria for twenty years

(6) The local people and those who visit this area from the North will have little or no immunity from malaria

(7) In many cases local houses and undoubtedly in most cases resort houses will not be properly screened

(8) Experience in other states indicates that the companies creating and owning such lakes have been held responsible for future malaria contracted in the vicinity of such lakes This has proved a costly item to the companies

(9) The Federal Power Commission in its permit to the Union Electric Company states that In the interest of public health the license shall

(a) Prevent the propagation of mosquitoes in the shallow upper reaches of the reservoir by distribution of oil or diluted Paris green powder in such manner as may be recommended or approved by the United States Public Health Service

(b) At all times be subject to the lawful jurisdiction of the State Board of Health of Missouri

(10) Experience indicates that this first year may witness the most serious malaria outbreaks unless prevention measures are undertaken

(11) Supervision and control will involve considerable time and money depending upon how the problem develops and should be at once placed under the direction of an expert malaria inspector

(12) With the exception of the Miller County Health Department ineffective health protection is provided by the counties and cities in the vicinity of the Lake and practically no local assistance toward malaria prevention or control can be expected

In view of these conditions it is requested that the following recommendations be carried out without delay

(1) That the deeds to all lands sold or leased by the Union Electric Company contain the provision that the contract of sale or lease is void unless the regulations of the State Board of Health of Missouri pertaining to malaria control and sanitation are strictly complied with

(2) That a program for mosquito control be developed including provision of satisfactory personnel and equipment

The following summary from the report of the Union Electric Company concerning control work during 1931 indicates the measures undertaken

The first equipment secured consisted of one 22 foot steel john boat equipped with an outboard motor oil drums and gas engine driven centrifugal pump Three 55 gallon oil drums were placed in this boat and interconnected to one outlet controlled with a gate valve This boat was placed in operation June 25 but was found unsatisfactory because of insufficient free board Five new 24 foot steel john boats were ordered with 9 inches greater free board and carrying 5 oil drums of 55 gallons capacity each To provide satisfactory flexibility in operation each boat was equipped with a 12 horsepower outboard motor furnishing a speed of five and one half miles per hour and a 32 horsepower outboard motor furnishing a speed of 10 miles per hour In order to secure a spray covering a strip fifteen to twenty feet in width and carried to a point eighty to ninety feet from the boat a four inch centrifugal pump directly connected to a four horsepower gasoline motor was installed in each boat

The larvicide used consisted of 80 per cent high grade kerosene and 20 per cent crude oil This mixture of oil was emulsified by the pump with water in the proportion of 99 per cent water and 1 per cent oil mixture Operators become experienced in controlling the spray by observing the oil film by a check on larvae control and by noting how much oil was necessary under various breeding conditions Normally each boat used 150 or 275 gallons of oil mixture per day The oil was purchased by the car load and distributed to various strategic distribution points on the Lake

During early summer no difficulty was encountered in covering the entire shore line However about August 20 a heavy rain raised the Lake seven feet This increased the shore line and when the water in the tributaries receded many swampy places were left which the spray boats could not reach This condition was controlled by increasing the number of knapsackers from six to twenty men Similar conditions existed following a drawdown

In order to check the effectiveness of the routine spraying procedure carried out at intervals of eight to ten days an inspection service was organized to dip for larvae and make adult mosquito counts at determined points situated around the shore line about two miles apart The records of these inspections were compiled in the main office at Lakeside and the oiling activities were controlled by these results. In conjunction with these records a daily record of the route of each boat was kept on an outline map of the Lake

The adult and larvae count continued to decrease from the first spraying until operations ceased on Oc

tober 8 due to the decrease in nightly temperature below an average of [illegible] F with the exception of the large rise in the Lake on August 20

Due to wave action in cleaning certain portions of the shore drawdown vegetation growth driftage and so on conditions affecting mosquito breeding will probably vary each year Knapsack operations may have to be extended making added oil distribution stations necessary and possibly more powerful spray pumps installed to reach the shore line where growths stumps and driftage collect It is further suggested that the inspectors familiarize themselves with mosquito control activities as related to home protection including screening and drainage so that owners can be advised on this subject

On September [illegible] 1931 an inspection was made of the mosquito control work carried out on the Lake of the Ozarks by Mr H A Johnson of the United States Public Health Service and a representative of the State Board of Health of Missouri The following recommendations contained in a report of this inspection summarizes the results of the first years work and suggestions for future activity

"In view of the conditions of the Lake and the apparently excellent organization maintained and functioning for the control of mosquito breeding the following recommendations are made

(1) That present mosquito control activities are adequate and that no change be made in the methods of control unless unforeseen conditions arising another season warrant the step

(2) That from a strictly malaria control standpoint antilarval measures maintained from about June 15 to October 1 would be satisfactory and the length of shore line now under treatment could be materially shortened The importance of watching the extreme upper ends of inlets and indentations should be stressed.

(3) It is probable that the winter and spring rains may wash floatage into the inlets and bights and produce mosquito breeding areas during the next season This condition should be watched for and remedied as it appears

(4) The removal of all floatage appearing should be considered the first line of defense against mosquito breeding

"(5) That the Company furnish the State Health Department with a monthly summary of antimosquito operations on the Lake in order that the Department may be able to give authoritative information in regard to conditions at the site

(6) That the Company keep itself informed in regard to malaria cases developing in the vicinity of the Lake and bring what pressure they can to bear to see that such cases are adequately treated. Cooperation with the State Health Department in this activity is strongly urged

A further check up of the influence of the Lake of the Ozarks on malaria prevalence was made in September and October by the Miller County Health Department The dam and a portion of this Lake are located in Miller County and this happens to be the only full time county health unit that has contact with the territory adjacent to the Lake Following reports of sickness and chilling in several families living on the Lake, a careful history and mosquito survey were made by the County health unit personnel Adult Anopheles mosquitoes were found in several homes where malaria cases occurred and dipping in nearby reaches of the Lake revealed many Anopheles larvae The houses visited were poorly constructed and unscreened Twenty five blood smears were taken of which 11 were positive however clinical symptoms indicated that a much larger number were suffering from malaria Instructions concerning the standard malaria treatment were given as well as instructions for mosquito proofing the homes

This check up by the Miller County Health Unit further emphasizes recommendation No [illegible] in the report submitted to the Company following a check up of conditions on September [illegible] 1931

The malaria control work undertaken by the Division in Southeast Missouri during 1931 was an extension of the work started in 1930 and covered in the Division report for that year The purpose of this program has centered on securing better screening of homes through malaria surveys, educational work and demonstrations. The territory covered has increased from one county to include the entire malaria district of southeast Missouri comprising 10 counties

Following is a tabulation of the educational activities carried out in this district

	Number	Attendance
Lectures in rural schools	130	3 200
Lectures in high schools	33	3 073
Lectures in college	1	50
Papers read before Lions Club Rotary Clubs civic clubs or parent teachers meetings Epworth League Boy Scouts etc	33	1 425
Bulletins distributed	8 000	
Posters placed	150	
Newspaper articles	325	
Circular letters	2 745	
Health exhibits	1	
Physicians contacted	50	

The following table shows relation between diagnostic and survey slides received by the district malaria laboratory

Table 1

Source	No Slides	No Positive	No Negative	Total Per Cent Positive	Per Cent Positive Tertian	Per Cent Positive Estivo Autumnal	Per Cent Positive No Type
Diagnostic	119	40	79	33 61	17 50	20 00	62 50
Survey	211	29	182	13 74	17 24	55 17	27 50

It will be noted from the above table that the incidence of tertian malaria is fairly constant whereas, estivo autumnal malaria fluctuates

Three surveys have been instituted one in Consolidated School District No 1 at Holland one for Missouri State Life Insurance Company at Bragg City and a third to determine the economic loss to school from malaria in Pemiscot County Partial result of these surveys are given in the following table

Table 2

School	Enrollment	No. Slides	No. Positive	No. Negative	Per Cent Positive	Date*
Channell	42	40	7	33	17 51	9 1 31
Samford	[illegible]	34	2	32	5 88	11 12 31
Holland	120	73	6	67	8 22	11 13-31
Portageville	196	34	5	29	14 70	12 9 31
Total	451	181	20	161	11 57	

* Date blood samples collected

From the Poisson Pearson formula the percentage of error in the above table is found to be 5 09

It will be observed from the above table that slide received from the Channell School show a higher positive percentage than those secured from Samford and Holland Schools notwithstanding the fact that all three school serve a territory of approximately thirty six square miles This variation is probably attributable to the fact that the slides from Channell School were secured during the peak of the malaria season whereas the slides from the Samford and Holland schools were received after the peak of the malaria season and represent latent cases It is the opinion of the investigator that had the slides from all three schools been collected near the date of September 1 malaria incidence in the three schools would have been about 17 per cent In this connection it might be noted that a higher percentage of positives was found in the Portageville School at a later date than either of the above This condition is probably due to the fact that the samples were secured from a group which was selected by the faculty The survey was not made to determine the malaria incidence in this school but was made at the request of the faculty to determine the cause for lack of initiative in this particular group

A survey was made at the request of the Wire Screen Cloth Institute to determine the potential number of unscreened houses in the following counties in southeast Missouri where malaria is most prevalent Butler Mississippi Stoddard Scott New Madrid Pemiscot and Dunklin

The results of the survey indicated that of the total of 5 054 owned houses in these counties 1 063 or 21 per cent were unscreened and 656 or 13 per cent were ineffectively screened and of the total of [illegible] 364 tenant houses in these counties 13 032 or 75 per cent, were unscreened and 2 171 or 12.5 per cent were ineffectively screened It is estimated that 1 114 000 square feet of screen wire will be required to effectively screen the houses in these five counties

Following is the result of a house to house survey in Holland School District No 1 exclusive of the town of Holland

Table 3

Approximate number of houses in district	480
Number of houses visited in district	285
Number of houses well screened	56
Number of houses not screened	229
Percentage of houses not screened	80.35
Approximate population in district	2 400
Number of people visited	768
Number showing history of chills and fever	265
Percentage of people showing history of chills and fever	34 5
Percentage of error in above sample	7 78
Blood slides made	30
Positive slides from above sample	9
Percentage of positive slides	30

Twenty two screen demonstrations have been completed in Dunklin and Pemiscot Counties

A simplified type of screen door for farm tenant houses has been standardized and advocated. The advantages of this door are square joints which present no difficulty in cutting cheap construction with remarkable strength and long life In a number of cases sawmills and lumber dealers have indicated their intention of specializing on the construction of this type of door Hardware dealers have been conferred with relative to handling only 16 mesh screen wire The cooperation of these dealers has been most encouraging

In general the practical accomplishments that it was hoped to secure in 1931 particularly toward screening of homes have not materialized This was partly due to a change in personnel and probably in a larger measure due to the extremely depressed financial condition of the southeast portion of the State

Contacts with influential landowners made in the year 1931 promise an increase in activities during the season of 1932

In these two malaria projects, the State Board of Health of Missouri has received hearty cooperation and excellent supervisory assistance from the United States Public Health Service However there are other isolated localities where malaria is a health menace and a number of communities in various parts of the State which desire to control mosquito breeding These projects, including the localities where malaria programs have already been organized have extended the profitable scope of the Division's malaria work to the point where an experienced malaria engineer should be attached to the central office in order that more adequate guidance and supervision and better technical advice be available and more concrete and extensive accomplishments may be secured.

MALARIA CONTROL IN MISSISSIPPI IN 1931*

By GEORGE E. RILEY, M.D.
Jackson, Miss.

The program developed by Dr. Mark F. Boyd in 1929 and followed in 1930 has been adhered to during the present year. This is a plan for execution by, through and with the whole-time county health departments. It was developed with a full appreciation of the meager resources and varied responsibilities of these organizations and the full realization that satisfactory results would require continuously sustained effort and support over many years. The "campaign" idea has been abandoned. The first two years of the operation of this program have demonstrated its soundness and workability. This program comprises the following activities:

(a) Encouraging physicians to greater precision in making diagnoses of malaria.

(b) Requiring physicians to report cases of malaria individually.

(c) Requiring county health officers to keep a spot map on which the exact location of all malaria cases are marked.

(d) Preparing educational material especially directed to schools and to the negro race.

(e) Promoting minor drainage.

(f) Promoting the screening and mosquito proofing of all homes.

The following progress has been made with this program:

(1) *Malaria Diagnosis.*—Physicians are urged to use malaria diagnosis as meaning an actual infection with malaria plasmodia. To make the use of the State and county laboratories more convenient, physicians are supplied with slide mailing outfits.

Either by information taken directly from the death certificates or by subsequent correspondence with the certifying physicians, it was ascertained whether or not the ante-mortem diagnoses of the deaths ascribed to malaria were verified by blood examinations.

In the first eight months of 1929, 3.2 per cent of the deaths reported from the State had been confirmed by microscopic examinations. In the same period of 1930, 17.1 per cent were confirmed as compared to 24.4 per cent in 1931, with seven physicians not yet heard from. During this same period the State Hygienic Laboratory and the seven county laboratories examined in 1930 13,293 slides with 1,751 or 13.2 per cent positive and in 1931, 9,196 slides with 790 or 8.6 per cent positive.

(2) *Morbidity Reporting.*—There were 620 individual case card reports made in the special morbidity reporting area as follows:

	White	Colored	Total
Bolivar	241	123	364
Coahoma	22	24	46
Humphreys	10	0	10
Leflore	29	9	38
Sharkey-Issaquena	17	0	17
Sunflower	21	17	38
Washington	1	[illegible]	1
Holmes	7	8	15
Warren	30	18	[illegible]
Yazoo	23	11	34
Total	*401*	*219*	*620*

The physicians of Mississippi and especially the Mississippi Delta, have been accustomed to reporting by number only for so long that individual case reporting is far from perfect and it is believed that this can be achieved only by educational means. The success attained in Bolivar County is largely due to the laboratory.

(3) *Malaria Spot Maps.*—A knowledge of the places where malaria occurs is the essential information the health department requires to intelligently develop a control program. This is secured by an accurately kept spot map upon which each case of malaria is located by a pin or mark. Some of the health officers utilize these maps and acquire a clearer knowledge of where their local malaria problems occur.

(4) *Educational Work.*—In Mississippi and especially in the Delta section, the education of the negro is the key to the malaria problem.

The negro version of the Rockefeller Foundation film "Malaria," which was developed by Dr. Boyd, is being used. The negro seeing this picture can understand that malaria is a disease of his race as well as that of the white and that he, too, should be concerned in its control.

"The Story of Malaria," a bulletin written by Dr. Boyd, is being used extensively in many of the schools of the State. The Division has developed a plan of cooperation with the State Board of Vocational Education whereby the subject of screening and mosquito proofing is taught in each of the vocational and trade schools of the State. There are 348 of these schools in 79 of our 82 counties. Bulletin No. 4 with the "why and how" of screening and mosquito proofing is used as a text, and the students are taught by practical demonstrations how to make and install the standard door, screen the windows and mosquito-proof the houses.

The colored posters prepared and distributed by the screen wire manufacturers have been used extensively and are of great value. We are anxious that they continue this valuable assistance.

(5) *Minor Drainage.*—This engineering service is an integral part of the county health department, and consists in the giving of lines and levels for minor drainage to individuals and municipalities without charge. These activities and the demands for this service have

*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 18-20, 1931.

increased steadily since its institution in 1929 This increase is shown by the following tabulations

	Number Surveys	No. Feet Surveyed	No. Feet Constructed	Percentage Constructed
1929	83	268 651	43 282	16 1
1930	273	669 699	200 089	29 8
1931*	284	602 583	2[illegible]6 200	37 5
Total	640	1 540 933	469 571	30 4

*To October 31 1931

We now have four engineers giving this service in ten counties In some of these counties there is a long waiting list of applicants The engineer in Bolivar Washington and Leflore Counties has appointments for surveys every day for the remainder of this year

In a very few cases we have at first met with antagonism from practising engineers however in almost all of these cases they have soon learned that our work did not encroach upon and was in many instances of material help in their work We have been very careful in the selection of engineers all of whom are capable and ethical

They have aided practising engineers in organizing drainage districts and by creating a drainage mindedness among the planters have increased their work on major projects This year there have been 44 miles of such work constructed as the direct result of such aid Hinds County using prisoners has regraded and dug new ditches of approximately 24 miles all of this work being urban in Jackson and in six adjacent towns

Many planters have taken advantage of the economic situation by using labor that had to be kept for farm work A great deal of work at a very low cost has been accomplished during this year The minor drainage accomplishments are summarized below

	Reported to [illegible] 31 1930	1931*	Total
Miles surveyed	176 [illegible]	125 83	302 63
Miles constructed	43 49	42 84	86 33
Acres reclaimed	2 187 60	4 153 80	6 341 40
Cost in dollars	21 789 [illegible]	8 858 75	30 648 60
Average cost per mile	501 03	206 79	355 02
Average cost per acre	9 96	2 13	4 83

*To October 31 1931

The fact should not be lost sight of that the drainage above noted was constructed at the cost of those benefited

One pond of 3 acres in the heart of the City of Greenwood is being filled in nine months it is one half finished This has saved the City street department 60 per cent of its hauling cost and will open two cross streets eventually reclaiming 4 acres of valuable city property We have found that this method is applicable in many towns and cities

(6) *Promotion of Screening*—Considering the conditions which existed in the Delta the screening program could not be considered unsatisfactory With five counties participating 1 459 standard doors were installed and 523 homes completely screened The screening accomplishments are summarized below

	Homes Screened	Standard Doors
Bolivar	6	18
Coahoma	[illegible]	30
Humphreys	25	56
Sharkey Issaquena	279	852
Washington	205	503
Total	523	1 459

A rural survey of 25 counties covering 3 201 miles and 13 133 houses showed 74 5 per cent owned 31.5 per cent tenant houses and 48 1 per cent rural houses were well screened

It is hoped that each of the 348 vocational and trade schools will completely screen five demonstration houses in its respective community thus giving protection to 1 590 homes and introducing screens in every community Mr F J Hubbard Director of the Mississippi Vocational Board of Education is to be commended for his interest and valuable assistance in this work

Until better conditions exist in the Delta we cannot hope to supplement the screening with papering Many planters will not screen tenant houses until the tenant has closed the cracks and openings with paper boards or cotton

(7) *Malaria Incidence*—The influence of the great drought and the subsequent remission of malaria in 1930 was reflected in all parts of the State this year The malaria cases and deaths were reported as follows in 1928 1929 and 1930

	Cases			Deaths		
Region	1928	1929	1930	1928	1929	1930
Delta	33 224	27 222	7 590	241	128	121
Bluff	16 847	15 660	7 729	111	62	37
Northeast	31 724	31 465	21 109	114	75	76
Southcentral	16 584	15 997	12 500	52	46	45
Coastal	506	701	540	3	[illegible]	2
Total	98 885	91 045	49 458	521	316	281

Somewhat changed by the change in the method of morbidity reporting

In 1929 98 4 per cent of the physicians reported and 99 27 per cent in 1930

In comparing the deaths ascribed to malaria during the first eight months of 1930 and 1931 for the Delta and the State at large we have

	Delta		State	
	Deaths	Rate per 100 000	Deaths	Rate per 100 000
1930	[illegible]	18 6	187	9.3
1931	40	9 7	82	4 0

The low carry over of malaria from last year has markedly checked its transmission over most of the State and it is probably safe to say that the malaria incidence in 1931 is the lowest in history This conclusion is corroborated by the morbidity and mortality reports the results of laboratory examinations and the opinion of practising physicians

(8) *Outlook*—The experience of the past two years has demonstrated the practicability of the foregoing

program. The control measures are popular and well received and paid for by those benefited. The outlook for 1932 is regarded with concern. It is desired to maintain the natural gains of 1930 and 1931 but in view of the economic conditions now prevalent it may be difficult to accomplish as much.

MALARIA CONTROL WORK IN OKLAHOMA*

By G. N. Bilby, M.D.,†
and
F. R. Hassler,‡
Oklahoma City, Okla.

Prior to 1928 there had been no active malaria control work done in Oklahoma and at that time certain counties in the eastern and southeastern part of the State were found to be quite heavily infected with malaria. There are only about 20 counties out of a total of 77 in the State that are considered malaria counties and of this number only about 12 or 13 have a heavy infection.

These counties receive the heaviest rainfall of any section of the State and the terrain is quite hilly and in some counties mountainous. A large part of the population lives in the valleys and those who live in the hills come down into the valleys in the fall of the year to pick cotton. The malaria section of the State has been in a poor financial condition for the past ten years and many doctors have moved to other sections of the State. Some of the counties have only four or five practising physicians in the entire county and some of these do not make rural calls. Because of these adverse economic conditions and lack of medical attention malaria had been neglected and had increased until a heavy infection prevailed.

Our report to this Committee given at Louisville last year gave an outline of the malaria control program that we are attempting to follow and this report also gave the results of a number of malaria surveys that had been made in several counties. During the latter part of 1930 and the year 1931 these surveys have been completed in all malaria counties and a screening survey has been made. The result of these surveys are shown in *Tables 1* and *2*.

It was evident early in the campaign that our two greatest needs were for educational work and for treatment of the existing cases of malaria. Mosquito control programs have been carried out in the larger towns in the malaria districts but there are very few such towns that have a mosquito problem. Our problem of malaria and mosquito control work is largely a rural problem and to date we have had little success in financing rural mosquito control work. The drought of the past year has aided greatly in the mosquito control work.

Table 1

INCIDENCE OF MALARIA IN OKLAHOMA COUNTIES
School Census*

Counties	No. of Families	No. of Persons	Positive History 1929	Positive History 1930	Per Cent Positive 1929	Per Cent Positive 1930
Atoka	887	5144	1299	—	25.2	—
Cherokee	451	2810	623	—	22.2	—
Choctaw	228	1390	432	—	31.1	—
Haskell	561	3381	1185	—	35.0	—
Johnston	630	3948	526	592	13.3	14.9
Latimer	202	1196	515	469	43.0	39.2
LeFlore	735	4414	1145	900	25.9	20.4
Marshall	445	2660	467	398	17.49	14.91
McCurtain	399	2480	803	—	32.4	—
Okmulgee	137	795	196	167	24.65	21.0
Sequoyah	693	4175	1231	—	29.48	—
Wagoner	1193	7358	1520	1117	21	15

*Census made by sending a similar card to the home from the school. Card was filled out by the parent and returned to the teacher by the student.

Table 2

SCREEN SURVEY*

County	Question No. 8† Yes	Question No. 8† No	Question No. 9‡ Yes	Question No. 9‡ No	Question No. [illegible]§ Yes	Question No. [illegible]§ No
Atoka	501	376	422	456	426	449
Cherokee	191	223	144	279	149	274
Choctaw	133	84	68	155	[illegible]	152
Johnston	466	193	385	294	391	281
Latimer	164	24	62	136	71	132
LeFlore	280	193	194	286	206	276
Marshall	262	122	172	223	168	225
McCurtain	186	200	125	265	149	238
Okmulgee	111	23	80	55	76	56
Sequoyah	306	177	281	196	305	163

*Survey made by sending malaria card to the home from the school. Card was filled out by the parent and returned to the teacher by the student.

†Are you troubled by mosquitoes in and around the house during the summer months?

‡Is the house completely screened to exclude mosquitoes?

§Is the family protected from mosquitoes during the night?

At the suggestion of the United States Public Health Service we have made a study of the Anopheles mosquitoes in Oklahoma this summer. With the foundation that we have prepared by the educational work and with the information gained from mosquito studies we plan to promote a screening and mosquito control program in certain counties next year. There are two counties that are heavily infected with malaria and they have full time health units and this work will probably be done in these counties.

Our educational work has been carried out through the office of county superintendents of school in each county. It has consisted of school visits, educational

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†State Commissioner of Public Health.

‡Assistant State Sanitary Engineer.

work in the school community night meetings with picture show, newspaper articles and the distribution of literature. We have had the cooperation of certain chambers of commerce and the civic organization, but unfortunately there are some counties that have no such organizations of any kind. Malaria control work in these counties is quite difficult.

The State has furnished quinine treatment free to indigent cases of malaria and for this treatment we are *using capsules containing four and one half grain quinine* bisulphate and one half grain powdered ginger. We have distributed approximately 800,000 capsules this year. *This has been distributed by* the local doctors, the county health officers, and the county superintendents of school. The standard 8 weeks treatment is given. We have also continued our "Pill Drills" in the rural schools. In these drills the pupils who have a history of malaria take the required number of capsules in the school rooms each day. Many teachers give these in the form of a drill twice a day in the schools. The adults in the school districts were also given treatment which they obtained from the local doctor if there was one, or from the school teacher. Records are kept and all reports are made to the Health Department through the office of the county superintendent of schools. We have found that the quininization work has increased school attendance, and that there has been a marked reduction in the number of malaria cases in Oklahoma *this year. We have taken our* malaria control program into every county in the State that has a malaria problem and using our past work as a foundation we hope to extend the work to include screening and more intensive mosquito control work next year.

MALARIA CONTROL ACTIVITIES IN TENNESSEE 1931*

By E. L. Bishop, M.D.†
Nashville, Tenn.

During the year 1931 the malaria control program of Tennessee included the continuation of projects already *begun and the inauguration of several new features.* Activities continued included *surveys of malaria incidence,* studies of Anopheline breeding, county-wide control measures of screening and use of larvicides, supervision of municipal mosquito control work, supervision of impounded water projects and roads de borrow pit control. This year there has been worked out a system of classifying dwellings (into four groups) according to the possibilities of mosquito proofing which can be used in malarious counties to estimate the task ahead in a screening campaign. There was also *started a better housing program looking to gradual replacement* of the poorer types of houses. On August 1, 1931, a second engineer was assigned to malaria control who will devote his time exclusively to minor drainage projects as they affect the landowner.

Surveys of Incidence.—The school blood surveys made in the fall of 1930, the results of which were not known when we reported a year ago, showed a considerable decrease in malaria incidence from that found in 1929. The blood incidence from *all summer school surveys for 1930 was 6.2 per cent, as compared* with an incidence of 10.8 per cent for 1929, despite the fact that *in two counties the 1930 surveys omitted the* school which had shown an incidence below 5 per cent in 1929.

This year blood surveys were made in the spring and fall in all the rural schools in Lake, Dyer and *Lauderdale Counties and in selected schools in* Obion, Tipton, Shelby, Hardeman and Humphreys Counties. As far as the results of these surveys have been received to date, they indicate a further reduction in malaria incidence for 1931.

Community Surveys.—*Surveys were again made in* three communities in Dyer County in June and September in connection with the Paris green dusting done by the United States Public Health Service. These all showed a further reduction in blood incidence of malaria beyond that recorded in 1930. The same is true of four communities surveyed in Lake County.

In Lauderdale County another blood survey was made on the Henning Farm in September 1931, where an intensive treatment campaign with quinine and plasmochin was completed in April and May, 1930. The blood surveys had shown an incidence of about *20 per cent for two years before the treatment campaign.* Four months afterward (October 1930) the blood incidence was 5 per cent. In September *1931* it was 2 per cent. These community surveys all indicate a lower incidence of malaria in 1931 than in 1930.

The Prophylactic Use of Plasmochin.—The administration of a single small dose of plasmochin once a *week during the mosquito season to each of the inhabitants* of an isolated community in Lauderdale County, which was begun in 1930, was continued this year. Whereas 22 per cent of the inhabitants had shown parasites in the blood before treatment was begun in June 1930, only 3 per cent were positive in October 1930, 1 per cent in June 1931, and there were no positives in September 1931. Owing to the general reduction in incidence elsewhere, however, no *conclusions can be drawn from these results. It is planned* to continue the administration of plasmochin for at least another year.

House Screening.—In Lake County the county-wide screening survey has been completed. The house-to-house *survey shows 125 houses still unscreened out of* a total of 1,840 dwellings in the County.

In Dyer, Gibson and Hardeman Counties, arrangements were made with local lumber yards to make

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*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 18-20, 1931.

†State Health Commissioner.

the United States Public Health Service type of door for local distribution. If the farmer desired to make his own doors, the lumber yards would sell him the material complete for the doors. Sketches showing how to assemble and hang the doors were prepared by the State Department of Public Health. Memphis and Humboldt passed city wide screening ordinances and have done excellent work.

Shelby County did county wide screening this year and utilized practically all the inspectors of the local Division of Sanitation in this work. Six hundred and fifty nine houses were screened this year with the United States Public Health Service type of door in the City and County. Many of the doors were made for the City Health Department.

Larval Control.—Shelby County and Memphis Health Departments cleared many miles of ditches and sprayed 130,000 gallons of waste crank case oil on ditches and bayous and had in addition 2,000 ponds in the County stocked with top minnows. 250 miles of streams and 522 miles of bayous were oiled in the past year.

The United States Public Health Service has continued the study of Paris green as a larvicide in Dyer County, where comparable areas under control and with no control are being studied.

Municipal Mosquito Control.—Most of the municipal mosquito control work consists of one or more of the usual methods of control such as clearing of ditches, oiling, drainage, house to house premise inspection and screening. The towns and cities doing malaria control work this year were Memphis, Millington, Covington, Mason, Ripley, Halls, Dyersburg, Newbern, Tiptonville, Ridgely, Union City, Dresden, Martin, Greenfield, Milan, Humboldt, Jackson, Brownsville, Nashville, Gallatin, Lebanon, Watertown, Cookeville, Murfreesboro, Pulaski, Fayetteville, Chattanooga and Knoxville.

A sanitary engineer from the State Department of Public Health prepares estimates of cost for the cities where needed and makes regular visits throughout the mosquito breeding season to insure more satisfactory progress of the work.

Impounded Waters.—The City of Cookeville continued regular oiling of its impounded reservoir on Falling Water River with good success. A power oiling boat with a gasoline air compressor attached to a fifty five gallon steel oil tank was used. The boat is large enough to carry sufficient oil to make the round trip of all the shore lines and small enough being of river skiff type to use in shallow water. The control accomplished is evidenced by the fact that upon inquiry this year no malaria cases were found in the vicinity of the reservoir while a few years ago when the work was inaugurated over 100 cases occurred.

The Tennessee Electric Power Company at their Rock Island Reservoir completed their clearing in the Wallace Bottoms, the last of the uncleared land subject to flooding at high water. This year corn was raised there instead of mosquitoes. They now have about 125 miles of shore line cleared two feet above the crest of the dam.

Roadside Borrow Pit Control.—Upon recommendation from the State Department of Public Health several years ago the Highway Department included in its specifications a clause requiring the contractors to drain all borrow pits and adopted the general policy of eliminating the making of new borrow pits altogether in so much as possible by more closely balancing the cuts and fills and if any additional dirt is needed borrowing from hills instead of making pits in low ground. The county highway departments have very closely followed up the policies of the State Highway Department in borrow pit drainage.

The agreement which the State Department of Public Health has with the State Highway Department on the drainage of roadside borrow pits along State highways was put into active effect this year. The agreement is that a sanitary engineer of the State Department of Public Health passes on which undrained pits are a health menace and the Highway Department does any needed running of levels and pays for the labor cost of the actual drainage.

The drainage done so far has been principally adjacent to towns and in built up rural communities where the most people would be protected per dollar of cost. In some instances it has been necessary to fill up the pits where drainage by ditching was not possible. In certain localities where drainage was not immediately feasible oil has been used.

Even during the present depression the Highway Department has continued this important phase of control.

Other Control Activities.—Several large sloughs in the Forked Deer River bottoms adjoining the City of Dyersburg were drained. The Red Cross furnished the labor, the City the tools and foreman, and the Health Department the general supervision. This drainage very materially relieved the local mosquito problem.

A rural tenant housing program was started, the objects being to secure building of better types of houses from a health standpoint for less money, to make the houses more attractive architecturally and to secure a grouping of tenant houses to make possible better sanitation and mosquito control in addition to other benefits of a sociological nature. The work so far has consisted of measuring houses most suitable as tenant types of houses and making pictures of them for architects drawings. Pictures for comparison have also been taken of the types of houses not to build.

A mosquito proofing grading sheet for dwellings has been drawn up with the plan that houses can be compared for percentage of mosquito proofness. Also a

classification system for houses based on their satisfactory or unsatisfactory construction, four grades being specified.

A classification of houses has also been made as regards mosquito-proofness. Their classes are A, B, C and D. A is a mosquito-proof house; B is a house screened and papered or ceiled; C is screened only; D has no mosquito-proofing.

Increase of Malaria Personnel.—During the intensive program carried out during the past four years the special malaria personnel of the State Department of Public Health has consisted of one full time sanitary engineer, one part time consultant epidemiologist, one or more special sanitary inspectors employed during the summer months and a technician. Recently funds have been made available for the employment of a full time physician as malariologist, a second full time sanitary engineer and a full time technician for blood examinations.

Field studies in malaria were resumed in the spring through the establishment, with the invitation of the Florida State Board of Health, of a station for malaria research located at Tallahassee under the direction of Dr. Mark F. Boyd. The phases of malaria selected for the initial studies include the inoculation of paretics by means of infected anophelines, not alone for the possible beneficial results, but more particularly since from a malaria standpoint the procedure is undertaken because it affords an excellent opportunity for studying the life history of malarial organisms.

During the past year field studies carried out by Dr. W. K. Stratman-Thomas in cooperation with the Mississippi State Board of Health revealed that in the Mississippi Delta at least the alleged ability of alfalfa fields to protect those living in their vicinity from malaria attacks is without foundation.

MALARIA CONTROL ACTIVITIES IN THE UNITED STATES IN WHICH THE INTERNATIONAL HEALTH DIVISION OF THE ROCKEFELLER FOUNDATION COOPERATED DURING 1931*

By JOHN A. FERRELL, M.D.
New York, N. Y.

The International Health Division of the Rockefeller Foundation gave modest financial cooperation during 1931 in Georgia, Louisiana, Mississippi, South Carolina and Virginia, granted in the main to assist in providing directive staff members to the state organizations. It is believed that a capable central office director can accomplish a good deal by constantly stimulating the county health departments to continue antimalaria activities.

The Mississippi program of integrating practical measures for malaria control with other local health activities undertaken by county health departments is being continued by the State Board of Health following the transfer of Dr. Mark F. Boyd of the Rockefeller Foundation Staff from that organization to other activities at the close of the past year.

Aid has been given to Professor W. H. Taliaferro of the University of Chicago to further the investigations of malaria in birds and monkeys.

*Read before Section on Malaria, Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 18-20, 1931.

SUBCOMMITTEE ON ENTOMOLOGY: REPORT FOR 1931*

By FRANCIS M. ROOT, PH.D., *Chairman*
Baltimore, Md.

In briefly reviewing the more important contributions made during the past year to our knowledge of the entomology of malaria, it seems natural to consider first studies on the taxonomy and morphology of the anopheline mosquitoes, since such information forms a necessary foundation for any entomological approach to the malaria problem. In America little work in this field has been done during the year. A few new species of Anopheles have been described by Davis and Shannon, but these are rare forms of no practical importance. In India Colonel Christophers and his associates of the Malaria Survey of India have continued to publish valuable studies on the distribution, varieties and limits of variation of the Indian species of Anopheles. In the Philippine Islands, revisional studies of the *A. funestus* group of species by Manalang, of the *hyrcanus* group by Baisas, and of the *ludlowi* group by King are deserving of special mention.

The easy identification of the early stages of Anopheline mosquitoes, particularly of their larvae, is of great value in survey work and may perhaps be of use at times during control operations. Our knowledge of the characteristics of the early stages of the anopheline species of the Old World tropics has been materially increased during the year through the publication of monographic studies by Christophers and Barraud on the eggs of the Indian species of Anopheles, by Puri on *Anopheles* larvae, particularly those found in India, and by Senevet on *Anopheles* pupae.

*Read before Section on Malaria, Committee (Conference on Malaria) meeting conjointly with Southern Medical Association, Twenty-Fifth Annual Meeting, New Orleans, Louisiana, November 18-20, 1931.

A practical trap for adult anopheline would be of considerable value in survey work although its importance as a control measure would probably not be very great. During the year descriptions of two such devices have been published. In the Philippines Manalang has used a trap in the form of a small house baited by a man protected by a bed net in his studies on the density flight range and natural infection rate of *A minimus*. And in the Canal Zone Bath has invented a trap to be attached to the window of an occupied bed chamber and reports that on one occasion one of these traps captured almost five thousand Anopheles during a single night.

Studies on the food of mosquito larvae and on natural conditions inimical to their existence are always of interest in connection with the possible development of biological control measures. Matheson and Hinman continuing their investigations on the destruction of mosquito larvae by *Chara* conclude that the lethal action is due to the large number of minute bubbles of oxygen given off by these plants. They also report the successful rearing to maturity of larvae of one species of Aedes and two species of Culex in water taken from natural breeding places and passed through a Berkefeld filter. In this connection it is interesting to note that Shipitzina in Russia reports that larvae of *Anopheles maculipennis* are able to strain out of water and ingest particles down to about 20 millimicrons in diameter but not particles as small as 5 millimicrons. This author believes however that although the larvae do utilize these colloidal particles as food they are not able to complete their development normally unless coarser food particles are also present.

Modern methods of malaria control which emphasize the desirability of restricting control measures to the species of *Anopheles* which are actually dangerous malaria carriers, so far as local conditions will permit make accurate information on the malaria transmitting ability of the different species of *Anopheles* a point of great importance.

In the Old World comparatively little work along these lines has appeared during the past year. Ramsay records natural infections in *A minimus* in Assam and Manalang has found many specimens of the same species naturally infected in the Philippines. Carter find *A culicifacies* infected in nature during malaria epidemics in Ceylon. Swellengrebel Annecke and De Meillon report a high rate of natural infection in *A gambiae* and *A funestus* in certain portions of South Africa. During the year also Covell has published a supplement to his earlier summary of transmission data for the anophelines of the world.

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Perhaps the most striking work of this sort which has appeared during the year is the report by Davis on conditions at Natal State of Rio Grande do Norte Brazil where the African species *Anopheles gambiae* has been accidentally introduced recently. In a series of 172 dissected specimens of *A gambiae* Davis found a total infection rate of 63 per cent a mid gut infection rate of 59 per cent and a salivary gland infection rate of 30 per cent. With such a fantastic infection rate among the Anopheles cases of malaria were naturally extremely abundant among the native population. The possibility of the establishment and further spreading of *A gambiae* on the American continent must be considered a very serious matter.

Finally although it does not deal with human malaria mention should be made of the work of Huff who has continued his studies on the hereditary nature of the susceptibility of *Culex pipiens* to infection by one of the bird malaria parasites. He now reports that this susceptibility to infection appears to behave in inheritance like a recessive Mendelian character. This work may prove the key which will enable us to understand why an anopheline species is dangerous in one part of its range but seems to be quite harmless in other areas.

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By E. L. FILBY, *Chairman*
Kansas City, Mo.

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How best to accomplish this and to make the effort carry on for some years to come has engaged the Committee's thought. Professor Saville indicated that a manual or outline of the engineering phases of malaria control could be utilized to guide and stimulate instruction in malaria control in engineering schools. Your Committee Chairman believed that such an outline could be developed into a series of five complete printed lectures illustrated by lantern slides and moving pictures. Thus engineering instructors could, with the lightest exertion, get the subject to the students. Sugar coating the quinine possibly, but can one expect a busy instructor with a crowded regular program to delve into the hundreds of pamphlets or hunt Dr. Boyd's "Malariology" in the library to *prepare his lecture?*

This viewpoint might not be acceptable to educators. Accordingly *Exhibit 1* was transmitted to the deans of engineering schools in that portion of the United States where malaria is a public health problem. About fifty letters were sent out. Only 18 answers were received, which in itself is indicative of the lack of interest on the part of engineering teachers in Southern states. More interest was displayed from the Philippine Islands than from any state! Apparently we must convince our educational authorities that malaria control is partly an engineering problem. Some of the replies indicated only a very small chance that the sugar coated ready to use lectures would be used.

There is need for a strenuous sales campaign to educate our educators.

In this the state health authorities, especially the engineer, can call conferences of the engineering and possibly medical educational authorities and attempt to inoculate them with the desire to spread the gospel of malaria control.

But the health engineers must have a definite program to present, and it is felt that a carefully compiled and edited series of lectures would be a satisfactory program. Either the state health department engineers or the regular school staff would present the matter.

This undertaking is by no means a simple one. Masses of data must be boiled down and presented in an entertaining and assimilable manner. All engineers on the Committee and some of our good medical friends were asked if they could assist in the preparation of such a series of lectures. Many agreed to accept assignment. A few ignored the request. This Committee proposed to combine the efforts of the various engineers and other workers and then submit the manuscript for critical review to a board of review composed of J. A. LePrince, Mark F. Boyd, Dr. L. L. Williams, Jr., and Professor Saville, thus combining the field, research and educational viewpoints.

The following outline for the proposed lectures is proposed, subject to your approval, each lecture to be

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†H. E. Legar, N. H. R[illegible], Thorndyke S[illegible], H. W. V[illegible], Hon[illegible]berg, E. L. Filby, Chairman.

REPLIES TO EXHIBIT 1

Reply signed by	Title	Favors Outline—Saville	Favors Lectures—Filby
M. L. Brittain	Pres., Georgia School of Technology, Atlanta, Ga.		Lectures
J. A. Switzer	University of Tennessee, Knoxville, Tenn.	Outline	
G. J. Davis, Jr.	Dean Engineering, University of Alabama, University, Ala.	Outline	
J. J. Wilmore	Dean Engineering, Alabama Polytechnic Institute, Auburn, Ala.	Outline	
L. L. Patterson	Dean Engineering, Miss. A&M College, A&M College, Miss.		Lectures
F. J. Sel[illegible]	[illegible] Va. Polytechnic Institute, Blacksburg, Va.	Would use both	
W. E. R[illegible]	Dean Engineering, University of South Carolina, Columbia, S. C.	Would use both	
B. M. Brigman	Dean Engineering, University of Louisville, Louisville, Ky.		Lectures
F. Paul Anderson	Dean Engineering, University of Kentucky, Lexington, Ky.		Lectures
J. H. Murdough	Prof. Engineering, Texas Technology College, Lubbock, Tex.		Lectures
E. W. Steel	Prof. Eng., A. & M. College, College Station, Tex.	Outline	
C. F. Hyde	Prof. Engineering, University of California, Berkeley, Calif.		Lectures
W. N. Gladson	Dean Engineering, University of Arkansas, Fayetteville, Ark.		Lectures
E. J. McCaustland	Dean Engineering, University of Missouri, Columbia, Mo.	Outline	
W. H. Schuerman	Dean Engineering, Vanderbilt University, Nashville, Tenn.	Outline	
Phil S. Donnell	Dean Ag. & Mech. College, Stillwater, Okla.		Lectures
Hilario Lara	Secretary School of Hygiene and Public Health, Manila, P. I.		Lectures
E. R. Hyde	Dean, University of Philippines, Manila, P. I.		Lectures
Dr. P. F. Russell	[illegible] Manila, P. I.		Lectures
Dr. W. C. Earle	Chief Malaria Control, Department of Health, Porto Rico	Does not this Committee [illegible] able to put out something worthwhile	

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Dr. P. F. Russell	International Health Division, Manila, P. I.		Lectures
Dr. Walter C. Earle	Chief, Malaria Control, Department of Health, Porto Rico	Does not think Committee able to put out anything worthwhile	

about six thousand words which is about fifty minutes Illustrations can be shown as the lecture is given or the lectures printed and distributed after a brief talk has been made to explain the slides and moving pictures

Lecture No 1—Introductory Malaria fever and its influence on engineering projects bringing in a definition of malaria, its method of transmission throughout the world its effect on development and industry what engineering works are affected and what the engineer can do Mr LePrince and such assistants as he may desire

Lecture No 2—Malaria fever how it is transmitted Breeding habits of chief transmitting host mosquitoes in the United States Central America India Philippines their flight range and biting habits the importance of knowing the transmitting host; agencies for identification of larvae adults catching of larvae adults field identification of adults Dr C H Bradley Dr W V King

Lecture No 3—Malaria fever and impounded water The relation of natural to artificially constructed lakes hydroelectric development regulatory bodies (Federal Power Commission S B of H) control during construction clearing maintenance operations water supply projects clearing and stripping of reservoirs water shed ownership as a malaria control measure Irrigation projects Messrs L M Clarkson G H Hazelhurst P S Fox and others

Lecture No 4—Malaria fever and transportation Waterways development canals railroads, construction and maintenance of way problems development of territory the economic toll of malaria highway development borrow pits culverts drainage obstructions control measures to prevent building malaria in Mr H W Van Hovenberg H R Fullerton N H Rector and others

Lecture No 5—Malaria control as an engineering project for the city or community drainage permanent control measures for the county or large plantation dusting fish control mosquito proofing for the project—labor housing short range control necessity for smear examination of all labor the use of plasmochin and quinine Mr A H Fletcher Dr T H D Griffitts H E Legare and Col C F Craig

Your Committee Chairman submits this program for your approval and asks definite instruction on the following

(1) Shall the subcommittee be instructed to prepare such a series of lectures during the coming year?

(2) Will the National Malaria Committee consider financing the preparation of lantern slides moving pictures, etc and printing of lectures if authorized?

(3) Will the National Malaria Committee sponsor the distribution of such educational material?

Care Black and Veatch Consulting Engineers

DISCUSSION PRECEDING SHOWING OF FILMS PREVENTION OF MALARIA BY SCREENING AND MOSQUITO PROOFING RESIDENCES, AND "MALARIA CONTROL BY DRAINAGE"*

By C C KIKER†
Montgomery, Ala

For some time the motion picture has been recognized as a most powerful agent in the hands of the educator This appears to be particularly true in the field of public health Many instances have come to our attention where the motion picture has been completely convincing of the facts after literature and spoken words had failed

The movement to establish county health units in Alabama gained considerable momentum shortly after the termination of the World War There existed a most fertile field for educational work. The motion picture was brought into service in many counties and played a most important part The standard 35 millimeter equipment however was rather expensive to purchase and operate and difficult to keep in working condition Heavy generators had to be transported for providing current in the rural sections There were few films to select from and these were expensive The State Board of Health attempted the operation of a film exchange It proved unsatisfactory and was finally discontinued In spite of these handicaps many shows were given In time however a majority of the county units grew weary of the burden and practically shelved a most important tool

Recent developments in the field of motion picture work have made available the relatively less expensive 16 millimeter films and equipment The State Board of Health realized the importance of reviving motion picture work in 1930 Sixteen millimeter equipment was investigated and a decision was made to purchase a camera and begin the production of some needed films At the time there was an urgent need for a film on screening as malaria control work in this connection was being inaugurated in several counties This first film was released in December 1930 Scenes were taken from actual work in progress according to a scenario which had been previously prepared. Titles were made by the Eastman Kodak Com

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Fifth Annual Meeting New Orleans Louisiana November 18-20 1931

†Assistant Sanitary Engineer Alabama State Board of Health

pany at a cost of 3 cents per word the total amounting to about $25.00. Scenes were taken on regular Eastman reversible stock though panchromatic film was used at a later date. The original by the reversal process is suitable for projection. About 8 rolls or $48.00 worth of film was used in taking scenes for the first film. After titles and scenes had been pieced together several prints were made from the original by the reversal process at a cost of about $20.00 per 400 foot film. This is the full length reel in the 16 millimeter size requiring fifteen minutes for showing and corresponding to 1,000 feet of the standard 35 millimeter size film.

Following production of the films on screening scenarios for three other films were prepared including one on drainage. They were completed early in 1931. *After investigation the reversal process of printing from* the original was abandoned in favor of the negative process and the cost was reduced to $10.00 per film. The International Health Board is supplying copies of the film Malaria for the cost of printing which is very reasonable. It is a 16 millimeter reduction from a 35 millimeter original. The photography is excellent. In fact, the superiority of reduced films over 16 millimeter originals is such as to warrant production by this method where initial cost is of secondary consideration.

There are a number of 16 millimeter projectors on the market ranging in price from $50.00 to $250.00 and more. We are using the Model C Eastman Kodascope equipped to operate on 110 or 6 volt battery current. Hand cranking is necessary where a battery is used for illumination. The projector costs $60.00. The whole outfit including the projector 30x40 inch screen battery and nine reels of film are being furnished our county health units at a cost of only $175.00. Fifteen of these outfits are being used in Alabama counties at this time. A number have been in continuous service for about a year now with little mechanical trouble reported.

We have standardized on 16 millimeter films on account of the relative cheapness of films and equipment the practical possibility of making local films at a reasonable cost and the ease by which equipment may be transported and shows given.

SYMPOSIUM ON MALARIA

Papers and Reports Presented before the National Malaria Committee, meeting conjointly with the Southern Medical Association at its Tweny Sixth Annual Meeting, Birmingham, Alabama, November 15 18, 1932

Reprinted from the Southern Medical Journal Journal of the Southern Medical Association Birmingham Alabama Vol XXVI No 5 May 1933 pages 447 473

SYMPOSIUM ON MALARIA

THE PART PLAYED BY A COUNTY HEALTH DEPARTMENT IN THE ULTIMATE CONTROL OF RURAL MALARIA*

By E L BISHOP M D **
Nashville Tenn

I had hoped to set a new precedent and spare you the boredom of a Chairman's Address but the Secretary informed me that such a precedent would be undesirable

Moreover he assigned the subject and gave instructions as to how it should be developed Since the principal function of any chairman is to follow the instructions of the secretary as best he may you will visit upon him such consequences as he may deserve

It was suggested that I try to discuss malaria as a county health problem from the viewpoint of the local *health department and with special reference to the* possibilities and responsibilities of the local department in the attainment not only of the smaller and immediate *objective but in the accomplishment of ulti*mate objectives as well

Almost it would seem such discussion is superfluous for malaria is a communicable disease requiring detailed community action for its control and the rendition of service in the accomplishment of such activity for the control of transmissible diseases is a prime function of any local health department Perhaps however the very complexities of malariology and the inherent difficulties of applying effective control procedures have served to discourage some of our rural health organizations when already we are faced by overwhelming tasks and utterly inadequate budgets Hence we are making excuses and not giving reasons

It seems to me we may accept as axiomatic the principle that the control of malaria is the direct and immediate responsibility of that element of government most intimately in contact with the community Certainly it is the principle we follow not only in control of other communicable diseases, but in most of the other functions of government Granting the truth of the principle it is immediately apparent that local health departments whether urban or rural constitute the first lines of defense and that the service of other agencies must be rendered through and with the local organizations.

Bringing the discussion of principles to a more limited application let us review rural malaria control in relation to rural health organization and activity and in addition the supplementary role which other elements of health organization must play Where it exists in the southern United States malaria is generally *endemic in prevalence but it reaches epidemic propor*tions only under some unusual combination of circumstances that usually are readily amenable to correction While in most states malaria prevalence is limited to a relatively small area in the aggregate the disease is second to few in its public health importance through the South Its chronic nature the fact that it is an endemic disease with high prevalence and complex epidemiology the further fact that the application of control measures varies with the area concerned make it obvious that the control of the disease involves not only a well conceived and detailed study of the local problems in relation to general principles but also the projection of any control activities over a period of years and perhaps indefinitely In other words the control of this disease is not accomplished by sporadic efforts but by long tedious unremitting and intelligent application of effort It is therefore perfectly apparent that a suitable organization for the administration of public health activity is the first prerequisite to the establishment of a malaria control program

Assuming that such an organization exists, its first concern should be the definition of the malaria problem and its public health significance Perhaps the most reliable index of prevalence particularly within the economic reach of the average rural health department is the blood index of school children Spleen surveys are important adjuncts and additional information may be gained from practicing physicians morbidity and mortality reports and community surveys All of this initial phase of the work can readily be carried out through facilities of the local health department with the laboratory service of the central organization being responsible for the examination of smears

When it is found that a problem exists and that it is one of public health significance there still remains the necessity for the collection of much additional detailed information of epidemiological importance in order that a community diagnosis may be made and a feasible plan *of control developed Such items as the type and avail*ability of medical service laboratory facilities for prompt and accurate diagnosis the location duration and extent of mosquito breeding the characteristics of breeding habits the extent and location of actual and potential breeding foci the stability industry and general make up of the population and housing and other social and economic conditions become matters of acute interest to the health department In other words there are three broad, though by no means exclusive classes of information that will be of interest namely (1) medical (2) social and (3) engineering but they vary so widely in different areas in their relative importance as to make each community a problem in itself for the development of malaria control

During this study phase and the collection of infor

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**State Commissioner of Health

mation the local health department must of necessity lean heavily on the expert technical and consultant personnel of the state health organization. Supplementary facilities obviously become necessary, but in the supplying of such facilities the integrity of function of the local health department should be preserved by the placement of the administrative direction of such personnel as may be detailed to the area by the state organization under the local health officer. With the acquisition of sufficient knowledge of local characteristics in the distribution of malaria, it follows that the formulation of a program of control activity is the next step. In this, too, supplementary service from the central health organization is essential and the local health department, unless it is unusual in the extent and character of its personnel, must lean heavily on such service; for unless both the study and projection of the program are developed with the most scrupulous care and attention to detail in the soundness of scientific procedure, the whole of the control activity which is to be established may have little or no practical value. *In no two communities perhaps can precisely* the same elements of control be combined into a local program and rarely, if ever, will a single measure be found sufficient.

Usually, especially in rural malaria work, the program rather *naturally divides itself into immediate and* ultimate objectives. For example, immediate objectives may be the screening of homes, the elimination or control of certain breeding places and similar activities, while the ultimate objectives may be major drainage *operations and major improvements in housing* and social organization. In both fields of service, however, the local health department retains the basic responsibility, but must use the service of the state and its consultant staff for the solution of its problems as *they arise*.

Finally, during the application of the control program that has been agreed upon there is need for continuing analysis and appraisal of results, and here, too, while the basic responsibility rests with the local health department, *supplementary service must usually be* available from a coordinating agency such as the state health department.

The foregoing more or less detailed discussion of the steps in the formulation of a malaria control program by a rural health organization *has been developed with* the single point in mind of illustrating the fundamental fact that precisely the same relationship, the same responsibilities and the same interplay of service and activity exist between the state and local health organizations with reference *to control of* malaria as is the case in any other communicable disease. In brief, the first responsibility directly rests upon the local health department just as it does for the control of tuberculosis or syphilis. The local health department must assume this *responsibility* and in the formulation of a malaria control program for a state the state health department will be well advised to encourage the establishment of full time local health departments throughout the area where control procedures are essential. Without such organization as a foundation the program will fail beyond any question, but even with reasonably adequate local health service there will remain the need for the same partnership between the state *and local agencies as exists in regard to other problems* in communicable disease control. Here, as in any other field of activity, the state organization must provide expert technical and consultant service both in the definition of the local problem and in the application of specific *control measures*; *it must supplement local* resources as regards the application of measures which cannot be provided by the individual community; it must engage in that research and investigation essential to the development and execution of a program state *wide in its application*.

All that has been said can be summed up in a paragraph about as follows: the development and administration of a control program for malaria does not differ in principle from that for other communicable diseases. It is approached through a definition of the problem in as specific terms as possible and the application of measures designed to meet the specific requirements. The place of local health organizations in the control of communicable diseases is well established and such organizations constitute the foundation upon which a public health program must rest. To be effective, therefore, any program of malaria control must be made a part of the general program of the local health department with such additional facilities and aid as may be necessary rendered through the state health organization and not set up as independent services.

RECENT ADVANCES IN THE EPIDEMIOLOGY OF MALARIA*

By Henry E. Meleney, M.D.,
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Your Subcommittee on *Epidemiology* has thought that it could best serve its function for the present year in two ways: first, by presenting a statement of the malaria mortality in the southern United States for the year 1931, and second, by reviewing certain *important advances* which have been made during the last few years in the study of factors related to the epidemiology of malaria.

The mortality report will be made by Dr. E. C.

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*Read before the National Malaria *Committee* (Conference on Malaria), meeting conjointly with the Southern Medical Association, Twenty-Sixth Annual Meeting, Birmingham, Alabama, November 15-18, 1932.

Report of the Subcommittee on *Epidemiology* of the National Malaria Committee.

Faust and represents a continuation of his study presented to the National Malaria Committee a year ago showing the mortality for 1930

In reporting advances made in the study of the epidemiology of malaria we have thought it best to limit our review to work done outside of the continental United States since you are already familiar with what is being done in this country and since the American aspects of the subject will be largely presented at the present meeting We should like however to call attention as a *matter of record* to the studies of Boyd and Stratman Thomas at Tallahassee and of Bruce Mayne at Columbia South Carolina on induced malaria produced by bites of infected mosquitoes to the studies on *Anopheles maculipennis* by Freeborn[1] in California and to the studies which are being made by the Bureau of Malaria Investigation of the United States Public Health Service and a number of state and local health officers of the southern United States All of these studies have an important bearing on the epidemiology of malaria in the United States as well as on its control

A report of this kind can necessarily mention only a part of the work which is being done in foreign countries It is based mainly upon information gathered through reprints and personal communications from leading malariologists in different parts of the world and from an incomplete perusal of articles appearing in current journals The Subcommittee wishes to acknowledge its appreciation for the cooperation of the workers who have contributed to this review and at the same time to apologize for the necessary omission of other work which is probably of considerable importance The review will be taken up by countries in order to attempt to form a picture of the methods and accomplishments in very large geographical unit

Beginning with South America we wish to call attention to the many studies which have been carried on upon Anopheles mosquitoes by N C Davis H W Kumm R C Shannon and R B Hill Many of these studies have been directed especially toward the incrimination of certain species of Anopheles as vectors of malaria The most interesting and important of these studies has been the discovery of the presence of *Anopheles gambiae* (*costalis*) in Brazil by Shannon[2] The mosquito was discovered in Natal on the coast of northern Brazil in 1930 and is supposed to have been carried to the Brazilian coast by one of the fast French mail steamers which makes the trip from tropical West Africa in four days The fact that this species is probably the most important malaria vector in tropical West Africa makes its appearance in South America a matter of considerable concern It was discovered in fact in connection with a severe outbreak of malaria in the City of Natal and seemed to have been responsible for the epidemic One of the peculiarities of this mosquito is that it is particular in the selection of breeding places being found mostly in small pools, often without vegetation and apparently requiring fresh water which is usually supplied by frequent rainfall It prefers water exposed to the sun but is sometimes found in shaded pools. Its presence is often increased by artificial conditions created by man and animals, such as borrow pits, drains open wells and hoof prints. Nelson was able to find the mosquito only in the City of Natal despite a rather extensive search for it in other neighboring regions along the coast and inland Larvae were found in small shallow collections of seepage and surface springs usually exposed to the sun and free from vegetation and predatory enemies Nelson concludes that because of the prolonged dry season in this region *Anopheles gambiae will probably remain highly* localized unless it adapts itself to local conditions or is carried to other regions in the New World more favorable to its breeding This is a striking example of the danger of rapid travel in modern times in creating new malaria problems

In Porto Rico the work of W C Earle[3] and others in incriminating *Anopheles albimanus* as the important malaria vector and in demonstrating the close relationship between the cultivation of sugar cane and the occurrence of malaria has already been reported to your Committee The studies of the epidemiology of malaria in Haiti by S S Cook[4] of the United States Navy *have also been reported before this Committee*

In Europe a most important and interesting development is the study of the possibility of the existence of more than one biological race of *Anopheles maculipennis* and its relation to the problem of malaria distribution and the occurrence of anophelism without malaria This study has been carried on independently for a number of years by several groups of workers For a time it was based mainly upon theory but with an intensive study of all stages of the life cycle differential features are being found which seem to be related to the problem of malaria transmission

Hackett and Missiroli starting with the classification on the basis of eggs by *Falleroni* in 1926 have made more definite the distinction between Falleroni's two races *labranchiae* and *messeae* by placing the differences in the eggs on a more definite basis Using these differences they have studied in cooperation with Martini of Hamburg the distribution of mosquitoes laying the two types of eggs and the relation of these *mosquitoes to the occurrence of malaria* La Face[6] has carried the study farther into the larval and adult stages, where suggestive differences are also found

Meanwhile de Buck Schoute and Swellengrebel[7] in Holland starting with the morphological observations by van Thiel in 1926 on racial differences in size have independently demonstrated differences between the *maculipennis* found in malarious regions of that country and the one found in non malarious regions. These differences are based upon the length of the wing sexual habits in confinement the fate of blood in the stomach during hibernation certain characteristics of the egg and larva and preference in type of water for breeding

The two studies seem to be converging toward a common point We have attempted to correlate them as follows the race *labranchiae* according to Hackett,

Martini and Missiroli[5] lays a dappled gray egg with small floats It prefers brackish water for breeding occurs in regions where malaria is actually or potentially present appears to be relatively more prevalent than the other race in human dwellings and does not go into complete hibernation It seems to have definite affinities with *Anopheles elutus* an important malaria vector in Palestine La Face[6] has shown that the larva of this race has a true palmate structure on the second abdominal segment and that in the adult male the claspette is conical and has one or two sharp hairs on its ventral lobe This race seems to be related to the short winged race of de Buck Schoute and Swellengrebel[7] which lays an egg having a small float in which there is no network in the intercostal film which is more domestic which breeds better in captivity and without swarming which digests human blood better in winter and does not hibernate and which has the advantage when breeding with the other race in brackish water It is also associated with the malarious areas in Holland The second race *messeae* according to Hackett Martini and Missiroli[5] lays an egg irregularly pigmented in bars with relatively large floats It predominates in fresh inland waters in Italy and Germany and in non malarious zones frequents stables more than dwellings and goes into complete hibernation in winter La Face[6] has found that this race in the larval stage has only a branched hair on the second abdominal segment instead of the palmate structure and that in the adult male the claspette is more or less quadrilateral and has a blunt external hair on the ventral lobe This race seems to correspond to the long winged race of de Buck Schoute and Swellengrebel[7] which lays an egg having a large float with a network in the intercostal film does not breed in captivity without swarming does not digest human blood well during the winter and is at a disadvantage when breeding with the other race in brackish water It predominates in non malarious areas Martini[8] and others still feel that caution must be used in assuming that the occurrence of malaria and anophelism without malaria in Europe is due entirely to the existence of distinct races of this mosquito and that other factors may be important in the solution of this problem It is evident however that the studies now in progress are directed along the proper lines and that they are furnishing evidence which may be of great value in the study of difficult problems elsewhere

Hackett and Missiroli[9] have also made a valuable study of housing as a factor in malaria A review by Clayton Lane[10] in 1931 indicated that there was still considerable difference of opinion as to the importance of house structure lighting and cleanliness in attracting mosquitoes to their food supply Hackett and Missiroli conclude that these factors are not important that mosquitoes return only by chance to the place where they have previously fed and that food preferences are the most important factors determining the place of visitation of mosquitoes

In Italy the important studies of malaria epidemiology and control in selected areas are being continued Unpublished information kindly furnished us by Dr Hackett brings out the following important observations In estivo autumnal malaria in Italy the pre epidemic season (May and June) showed a conspicuous percentage of gametocyte carriers in the younger age groups but none over 12 years of age On the other hand the influence of age in the contraction of estivo autumnal malaria is not so important as in benign tertian malaria Although children are more receptive than adults to *P falciparum* infection the parasite still attacks a large percentage of older individuals In benign tertian malaria on the other hand the disease is prevalent only in early infancy becoming relatively scarce after 12 years of age but the peak of the disease occurs earlier in the year because of the large number of spring relapses in children making gametocytes available in large numbers to the few anophelines which appear early in the year Very few relapses of tertian malaria in adults are reported and evidence is found that malaria appearing in the spring in Italy is due to a prolonged incubation period of infections acquired in the previous year without clinical manifestations The Italians also found that treatment with quinine for at least 60 days in the previous year did not lessen the tendency of benign tertian to relapse in March after an interval of 24 to 30 weeks They conclude that tertian malaria prevails in June and July owing to the large number of gametocyte carriers in the pre epidemic period and that estivo autumnal malaria prevails in July and August because of a greater receptivity of older age groups of the population They also believe that the proper time for measuring endemic malaria in Italy is the period January to March in which the level of endemic malaria will hardly show any effect of intensive treatment during the previous fall

We have obtained the following information from Dr W S Leathers concerning malaria studies now being carried on in other countries in Continental Europe

In Corsica the French under the direction of Professor Brumpt are making intensive studies along lines similar to those in Italy

In Spain studies on the Central Plateau under the direction of R H Hill show that a moderate amount of non malignant malaria exists The flight range of *Anopheles maculipennis* about the malaria station at Campolugar has been found to be more than four kilometers or two and a half miles Directions of flight are being studied by catching mosquitoes on sticky fly paper Mention should also be made of the government institute of malaria at Navalmoral where important epidemiological studies are being made

In Hungary a survey of malaria has been made by the Professor Parasitology of the School of Public Health at Budapest A large amount of non malignant malaria has been found irregularly distributed in the southeastern part of the country

In Bulgaria intensive malaria studies and control measures are being carried on under the direction of R K Collins From a malaria station at Petrich work is

being carried on in a large surrounding area including eleven towns with a similar number of towns acting as controls In the region of Plovdiv rice fields have been found to be a prolific source of *maculipennis* breeding and a plan of alternately flooding the fields for three days and draining them for eight has been suggested for their control Epidemiological studies have shown that Paris green dusting filling and drainage must all be used as control measures

In Albania Hackett is making epidemiological studies which indicate that the malaria problem is largely associated with the cultivation of rice

In Greece M C Balfour is in charge of malaria investigations in cooperation with the government and Dr M A Barber has a special malaria station at Cavalla in northern Greece

In England the principal studies have been conducted in connection with induced malaria S P James Nicol and Shute[11] have made a study of infection with *Plasmodium falciparum* and have brought out important differences between the course of that infection and that of benign tertian malaria These workers found no evidence of prolonged latent infection such as sometimes occurs with vivax The incubation period varied from 6 to 17 days They found that recrudescences occurred sometimes after a longer period than in benign tertian malaria and that these merged into the periods of the so called relapse and recurrence of benign tertian infection In their small series of seven mosquito bitten cases none suffered from a typical relapse or recurrence They found that their cases infected by direct blood inoculation and by bites of infected mosquitoes behaved the same way in regard to recrudescences after the primary attack had been stopped by quinine This is also in contrast to benign tertian malaria where blood infected cases were much less likely to relapse than mosquito infected cases They found that quinine treatment of the primary attack brought about a permanent cure in less than 10 per cent of the cases of *falciparum* infection whereas 50 per cent of the benign tertian cases were cured About 20 per cent of the patients continued to harbor parasites for a longer or shorter period after an apparently complete clinical recovery They confirmed the impression gained from clinical observations in naturally acquired *falciparum* infection that it is primarily an acute disease in which the primary attack is the only one in which there is grave risk of pernicious symptoms (except for black water fever)

Important studies in Africa have been made by Swellengrebel and his co workers in South Africa[12 13] by Barber and his co workers in Nigeria and Liberia[14 15] and by Gordon and Davey in Sierra Leone[16] In South Africa the studies have brought out the importance of distinction between farm malaria and estate malaria The farm problem concerns mainly the non immune white population living amongst a relatively immune native population in an endemic area whereas the estate malaria concerns *mainly the native labor force* which is often recruited from other non malarious regions Farm malaria scares away new white settlers, whereas estate malaria scares away fresh capital These studies have also emphasized the difference between endemic areas and epidemic areas, which are distinguished by their climatic conditions by the relative immunity of the inhabitants and by the mosquito vectors *Anopheles gambiae (costalis)* which is dependent almost entirely on local rains for its breeding places, is mainly responsible for the occurrence of epidemics in wet years and is always largely responsible for endemic malaria in regions with frequent rainfall The other important vector *Anopheles funestus* is not dependent upon local rains for its breeding because it is a stream breeder It is important in some regions in the maintenance of endemic malaria but in other regions is not found in houses and is not apparently a source of infection Swellengrebel[1] believes that the chief source of infection of anopheles for the white population in an endemic area is the native population and that the chief place of infection for the mosquitoes is within native huts rather than in the open He believes that the equilibrium established by the white population is an unstable one dependent upon the adjustment of Europeans to local condition and that there will always be great danger of epidemics from the importation of non immune laborers into endemic areas The decision as to whether a region is suitable for economic development must be dependent upon the results of a careful study of malaria in the native population

In studies made in the Transvaal and in Zululand Swellengrebel and his co workers[13] have again found *Anopheles gambiae* and *Anopheles funestus* to be the *principal* vectors, and they believe that the high rate of infection of these mosquitoes is particularly due to the absence of stables to attract mosquitoes away from man The native black population shows a considerable racial resistance to malaria in early childhood notwithstanding heavy infection It shows an acquired immunity later on by reduction of the parasite rate and by a high spleen rate and in adults an additional acquired tolerance with a lower spleen rate and still lower *parasite rate They believe that both the white and* the Indian races are less able to shake off the after effects of malaria (enlarged spleens) than the native race even when the latter has not become immunized by constant or repeated infection

The studies of Barber and his co workers in tropical West Africa have been equally valuable In southern Nigeria[14] they have found that nearly all of the native population becomes infected with malaria during infancy *and that the children suffer far more with the* disease than do adults *Anopheles gambiae (costalis)* is the chief vector in the vicinity of Lagos whereas *Anopheles funestus* also becomes important in the inland hills Three other species may also be important in southern Nigeria The danger of infection is great in all months of the year but especially in August and September They found that a very low adult density of *Anopheles gambiae* is adequate to keep up a high *malaria rate because of the high index of mosquito* infection In Liberia[15] a study has produced somewhat similar observations

An interesting study has been made by R. M. Gordon and T. H. Davey[16] in Freetown, Sierra Leone, of the rapid increase of quartan malaria. Since 1925 this infection has spread from a small section of the city over the entire community. The increase in quartan infection seems to be at the expense of estivo-autumnal malaria, since no general increase in malaria has occurred. In the last survey 68 per cent of the positive specimens showed *P. malariae*. These men were unable to infect either of the two common vectors of tertian and estivo-autumnal malaria in the region, namely, *Anopheles gambiae* (*costalis*) and *Anopheles funestus*. They believe, however, that if *P. malariae* is transmitted by an anopheline mosquito in Freetown, *A. gambiae* is the sole or chief vector.

Kligler and his co-workers in Palestine have continued their malaria studies, particularly with reference to the movements of Anopheles mosquitoes at various seasons of the year. They have studied the behavior of *Anopheles elutus* and of *Anopheles superpictus*. Kligler[1] concludes that although different species behave differently during the active breeding season, the range of dispersion is far greater during the prehibernating and hibernating period than during the active breeding season. He finds that infected mosquitoes behave like non-infected ones. He believes that in Palestine zoophylic strains or races are the exception rather than the rule and that under conditions prevailing in subtropical and tropical countries, the belief and food preference of the anopheline vectors are regulated by temperature, humidity, light, wind and available food supply.

In India it should be noted with regret that Colonel S. R. Christophers has retired from the directorship of the Central Malaria Bureau, but the work will undoubtedly continue with equal efficiency under the directorship of Lieutenant Colonel J. A. Sinton. Many studies have been made within the last few years on the epidemiology of malaria in India attempting to produce a thorough understanding of the problem before concerted control measures are instituted. Noteworthy are the studies in the State of Sind in northwest India by Covell and Baily, the surveys by G. Macdonald and his co-workers in the Punjab, in Bikaner State and in Assam, the studies by Covell in the Patiala State, the Punjab and in Calcutta, and the surveys by Sinton in Kathiawar, north of Bombay. These studies are all published in the Records of the Malaria Survey of India. The study in Sind was started by McCombie Young[18] in 1927 for the purpose of discovering the probable effect on malaria of the Sukkur barrage scheme which contemplates the prevention of extensive flooding of the territory adjacent to the lower reaches of the Indus River. The studies of Covell and Baily[19] indicate that the principal or sole vector of malaria in Sind is *Anopheles culicifacies*, which breeds in subsiding flood water drained off from rice fields and in water leaking from canals into borrow pits. Malaria is most highly endemic in regions where flooding is greatest, and epidemics depend upon the occurrence of excessive floods and come at a time when the floods are receding. They believe the barrage scheme will decrease epidemic malaria by decreasing extensive floods, but that endemic conditions may be made worse if the level of the ground water is materially raised.

Of special interest is the study by Macdonald[9] of the mechanism of malaria infection in children and the significance of various degrees of splenic enlargement. Combining his observations in Sierra Leone in West Africa with those in Assam, he concludes, first, that only 60 per cent of infections are discovered by our present method of thick drop blood examination; second, that the parasite rate among those with enlarged spleens is always about 60 per cent in most endemic areas; and third, that a true infection rate can be calculated from the actual parasite rate by multiplying it by a factor based on the parasite rate among those with enlarged spleens. He believes that only some 50 per cent of infections are of sufficient severity to produce enlargement of the spleen. As a result of his study in Assam he concludes that the parasite rate reaches its height in heavily endemic areas in the first two years of life, after which it decreases, and that the spleen rate reaches its height at from three to six years and thereafter declines. He finds that a large spleen is generally associated with a moderate parasite infection, whereas small spleens are associated with either a very small or very high parasite count.

In a later paper Macdonald[1] presents a theory of the cause of the various degrees of splenic enlargement. He believes that the initial attack of malaria causes a relatively slight enlargement of the spleen, possibly due to temporary engorgement only. When an individual has suffered for two or more years from splenic enlargement a definite hypertrophy takes place, although the size of the spleen remains unaltered. A recurrence or a relapse in an individual with a spleen of this type results in further enlargement. Very large spleens are due to frequent reinfection in an individual who has for some years suffered from splenic enlargement, but in whom immunity is not well developed. Very small spleens are due to a light attack of malaria and the mildness of the attack is very frequently due to a partial immunity. An excessive spleen rate of this type indicates that the amount of malaria infection is static and that immunity is well developed.

The malaria studies in the Philippine Islands during the past few years have been mainly devoted to a clarification of the previously confused Anopheles groups by Baisas and by W. V. King, to a study of the habits of different species and to malaria surveys by P. F. Russell and R. L. Holt. Russell reports that malaria has been found to be a problem only at the junction of the plains and plateaus with the foothills and is due to the concentration of breeding of the *funestus minimus* subgroup of Anopheles in the running streams in these localities. In addition to this work we should call attention to the study of the experimental epidemiology of avian malaria by P. F. Russell[3] in which an attempt is being made to reproduce in bird colonies conditions existing in human popula-

tions These experiment st ll seem to be in their initial stage

In China it is encoura ing to note that a beg nning is being made in the inten e study of the malaria problem through the encoura ement of the League of Nations and by the establishment of a Divis on of Malariology in the Ce tral Health Administration at Nanking Mo quito studies by trained Chinese med cal entomologists al indicate that the malaria problem in China may be more vigorou ly attacked in the near future

The Subcommittee realizes that this is a v ry made quate presentation of an immense subject but the material presented indicate that a great amount of intell gent effort is being expended throughout the world in a better under tanding of the epidemiology of malaria

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SOURCES OF REMEDIES FOR MALARIA*

By W T DAWSON M D
Galveston Tex

As is well known the principal remedies for malaria are cinchona alkaloids, and of these quinine is of para mount importance The latest government bulletin on the production and marketing of quinine appears to be T ade Information Bulletin No 273 published in October 1924 by the Bureau of Foreign and Dome t c Commerce of the Department of Commerce This bulletin is now out of print but a copy was kindly made available for in pection by C C Concannon Chief of the Chemical Div ion of that Bureau The report indicate a ubstant al Dutch-controlled monop oly in the cinchona industry but states that t is not clear that the control of the Dutch monopoly has so far been in any way harmful to the general interest " Dr Concannon states that the Kina Bureau Amster dam controls the production and distr bution sales prices and so forth of an estimated 9 per cent of the world s supply of cinchona bark

A bulletin Quinine in South America published by the Pan American Un on Washin ton D C is of interest

Statistics giv n by Dr Concannon a to South Amer ican expo t of bark in 1930 show possible totals of

Bolivia.	90 tons (metric)
Colomb a	1 5 tons (metric)
Peru	22 tons (metric)
Ecuador	.63 tons (metric)

The Un ted States app ars to be a minor factor in the trade in South American bark mo t of it go ng to Europe

The followin commu ication to Dr J J Durrett fr m Dr P B Dunba Assistant Ch ef Food and Drug Admini tration United States Department of Agricul ture is of interest in connectio with the cinchona sup ply of the United State and the compo ition of the malaria emedies o the market ome of which are known commonly as chill tonics

"Most of the cinchona bark ent ring this cou try comes through the port of New York I therefore requested our New York office to f rnish whatever informat on relati e to import is availab e Our ta tio s do not attempt to examine all consignment of cinchona bark offered for entry It is estimated that between 60 and 80 per cent of such importations are examin d by our laboratories We would have no rec ords of importat ons which are not sampled During the pa t five years we have exam ned samples f om

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*R ad befor S on t M la C mmittee (Conf on Malar) meet g conjo ly w h Southern Medical Association, Twen y S th A l Meet g Birm gham Alabama, Nov mbe 15-18 1932

Report f th S bcomm tte on So ces f R medies for Malaria, Pr fesso W T D wson, Chairman

From he Departme t f Pharmacol gy School of Medicine U ers y f T xas.

consignments totaling 410 000 pounds Of this amount 2300 pounds were denied entry because of low quality The rejections therefore amounted to approximately one half of 1 per cent of the goods offered for entry

In 1928 this Administration inaugurated a systematic survey of preparations on the market labeled as treatments for malaria We had of course given consideration to medicinal preparations generally including those represented as treatments for malaria from the date of the passage of the Federal food and drugs act I find in our files 122 notices of judgment which include references to malaria among the label statements alleged to be false and fraudulent Many of these notices of judgment relate to products of the cure all type in which malaria is not emphasized beyond the numerous other disease conditions for which the products were offered Many of the notices of judgment on the other hand are based upon the alleged misbranding of products offered primarily as treatments for malaria

Of course not all of the preparations which have been considered by the Administration are represented by notices of judgment When our intensive survey of malaria preparations was inaugurated many manufacturers voluntarily submitted the labelings for their preparations to the administration for comment In this way a considerable number of them were given consideration without the formality of a legal proceeding

The compositions of the numerous drug products we have examined varied widely Most of them contained quinine or other cinchona alkaloids In many instances however the proportion of such alkaloid was considered too low in the light of the doses recommended to constitute an adequate treatment for malaria Other ingredients often found in these preparations are powdered iron or a soluble iron salt and laxative drugs Among the laxatives found are Epsom salt the emodin bearing drugs (cascara sagrada senna rhubarb aloe) phenolphthalein and podophyllum oleoresin Arsenic and strychnine also are ingredients of some of these articles

A very important discovery has been announced within recent months by Dr Paul Rabe the eminent German chemist called to our attention by Dr Concannon The search for a method of synthesis of cinchona alkaloids has at last been successful (Berichte 64 2487 1931) While quinine has not yet been synthesized hydroquinine and hydroquinidine have now been produced by complete synthesis These alkaloids are considered by the German authority Giemsa as at least of equal value to quinine in the treatment of malaria It is possible that these alkaloids cannot yet be synthesized on a commercial scale at prices that would enable them to compete with quinine but it is certain that German chemists will attempt to make commercial production possible In this country Bevil (*Amer Jour Trop Med* 12 4 3 1932) has recently reported favorably on the value of hydroquinidine in the treatment of malaria

Within recent months favorable reports have appeared on the antimalarial activity of a new drug atebrin or atabrine stated to be a complex derivative of the acridine series and of another preparation of somewhat similar name tebetren stated to be a combination of hydroquinine and methylacridine (Lancet 2 565 1932) and also of a quinoline derivative R 118 (Klin Wchnschr 10 987 1931) The formula of plasmochin previously kept secret has at last been disclosed (Klin Wchnschr 11 381 1932)

It is clear that there have been during recent months developments in the field of organic chemistry that are of great interest to everyone concerned with the treatment of malaria

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MALARIA MORTALITY IN THE SOUTHERN UNITED STATES 1931*

By Ernest Carroll Faust Ph D

New Orleans La

A year ago the writer presented to this Committee the status of malaria in the South determined by the mortality rate for 1930 The data indicated that decrease in the malaria death rate had occurred in recent years although in certain areas the situation was essentially the same as it was a decade ago In fact in a few states rates in excess of 10 per 100 000 population had increased within the decade As a whole there was adequate evidence to indicate that malaria was still a public health problem in many regions of the South

The record for the year 1931 has been compiled by states and by counties and is now available for review Of the 14 states within the area (Virginia North Carolina South Carolina Georgia Florida Kentucky Tennessee Alabama Mississippi Missouri (southern 3 tiers of counties) Arkansas Louisiana Oklahoma and Eastern Texas) all but three showed a decreased death rate from malaria for 1931 (*Table 1*) The rate for North Carolina is higher by 0 1 for Texas by 0 54 and for Missouri by 5 62 (or more than one third) In considering the data by counties these three states show an increase in the number of counties reporting more deaths than in the previous year Moreover in Arkansas with a marked reduction in the death rate for the State as a whole there is a 44 per cent increase in the unfavorable county group Relatively few of the counties reporting deaths for the year 1930 had the same record for the year under consideration deaths either increased or decreased On the other hand large percentages of counties in Virginia (83 per cent) Kentucky (75 per cent) North Carolina (62 per cent) and Tennessee (53 7 per cent) had no deaths from malaria for the biennium 1931 1932

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*Read before the National Malaria Committee (Conference on Malaria) in conjunction with the Southern Medical Association Twenty-Sixth Annual Meeting Birmingham Alabama November 15 18 1932

From the Parasitology Laboratory Department of Tropical Medicine Tulane University School of Med

Table 1

STATE AND COUNTY DEATH RATES FOR MALARIA FOR 1931

Stat	1930	1931	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 1930	[illegible]	[illegible] 1930 [illegible] 1931	[illegible]	[illegible]
V g	0 62	0 5	5	5	10	10	2	2	83	83	100
N th Ca l	1 4	1 5	17	17	18	18	3	3	67	67	100
So th C l	19 26	13 6	13	28 2	1	4 6	6	13	6	13	46
Ge g	15 20	10 5	36	22 3	54	33 5	20	12 4	51	31 6	161
Fl d	1 6	13 6	15	2 3	6	5 7	10	15	6	9	67
K t ky	2 1	0	14	11	1	10	3	2 5	90	75	1 0
T es	5 4	5 3	17	17 8	21	2 1	6	6 3	51	53 7	95
Al b m	11 7	8 1	17	25 3	16	51 7	9	15 4	5	7 5	67
M ssis ri	13 9	10 35	22	6 8	4	4 8	9	11	6	7 3	82
Musso	15 4	21 0	12	36 3		1	1	03	1	40	13
A ka sas	30 3	6 9	11	14 6	44	1 6	16	1 5	4	5 3	5
Lo ia		6 8	18	8 1	1	50 0	5	7 5	9	14	[redacted]
Oklah m	5	3 5	15	20 2	4	3 4		6 5	0	40	74
T xa	66	4	50	9 4	45	4	6	3 5	69	40	1 0

MALARIA MORTALITY IN 1931

R g n Sh g M k d I cr

	M t lts Rat	I g O 1930
(1) C b		
C p C ty	6 8	1
E ly C ty	59 4	11 9
Lib ty C ty	2 1	1
M I tosh C t	1 1 0	69
(2) M rl		
B tl C ty	0	0 23
D kl C ty	4	0 05
N w M d d Co ty	40 5	19 6
P m scot C ty	06	30 93
(3) A k sas		
G ee C ty	3 1	27 1
M tg m ry Cou ty	65 0	65 0
I rv C ty	0	[redacted]
(4) M ipp		
Q tm C ty	54 1	2
(5) Lo na		
Mad so Parish	52 2	18 7
(6) Okl h [redacted]		
P hmat l C ty	61 0	3 0
(7) T xas		
C ag C ty	55 8	8 5

On the other hand the follow had important re cessi ns

R gio Sh g Import t R

	M l Rs	P C t Red
(1) S h Ca li		
Be fort C ty	96 0	8 4
Berk y Cou ty	53 9	90 1
Geegr n Co y	53	46 1
J per C ty	33 3	39
(2) Ceo g		
B k C ty	5	79
Bl kl y Co ty	1 6	88 4
J k C ty	51 8	154 2
Le Co	4 9	7
M h ll C y	9 1	42 4
(3) F rida		
C t Cou t	10 1	92 9
D C ty	159 4	140 6
G dsd C ty	4 3	46
J ff ty	17	93
L f tt C y	2	73 1
Le C ty	0 1	113 7
(4 Al b ma		
C ee C t	0 1	30 45
M t m y C t	9 6	0 6
(5) M ss pp		
B l C ty	15 1	13 0
Coah m t	27	17 6
(6) A k nsa		
A h y C	11 9	8 1
B dl y Co ty	5 6	3 4
D h C t	41	30
D w C unty	5 1	49 9
H t Sp Cou ty	11 0	4 0
J ff C y	3	1
L l C n y	9	45 4
L t R er C y	19	4
M R C t	4	6
Ph l ps C	6 9	61 1

On the h le the year 1931 ha sho n a r table d cl ne in the a ea w th only e large se ti n (So th ea t rn Mi souri) serious l d p rt fr m the fa or able howing h h at had mad d the p ous decade

OBSERVATIONS ON THE APPLICATION OF MOSQUITOES IN MALARIA THERAPY*

By Bruce Mayne,**
Columbia, S. C.

*When one investigates the cost of potentially infective mosquitoes one realizes that unstinted care is necessary in transporting these precious lives. When mosquitoes are to be transported for therapy they should be personally conducted. In England, where the distances in any quarter are never greater than 24 hours apart, anophelines are given a caretaker none other than the assistant director of the malaria laboratory. The insects are conveyed in lots of about fifty in wide mouthed cylindrical glass museum jars with one end netted. There appears to be no effort to conserve the specimens in an ice container while en route. Of course the summer conditions there differ from ours. Here we employ a portable refrigerator maintained at a temperature, if possible, of 40 to 50° F. When more than one day's travel is necessary the ice container must be replenished. The insects are preferably kept in individual diminutive lantern globes of the sort employed in routine biting in the base hospital. The original record number is retained throughout the life of the insect and pertains to it: character, contacts and performances. Where possible the following has been the procedure adopted.

When a number of patients require treatment each is bitten by every available mosquito of the batch which can be induced to attack the host. An interruption ensues at intervals of thirty seconds, using the same insect until it refuses to bite. Usually it is permitted to engorge itself on the final host. When only a single host is offered the mosquitoes are applied singly and immediately dissected. If the salivary glands of a test mosquito show an abundance of organisms the biting is discontinued and, where possible, the glands are injected in a suspension of sodium citrate into the vein of the patient. In this connection conservation of material may be effected, if desirable, by using one patient to receive the bite and another for the intravenous injection of the suspension of salivary gland sporozoites. Of course one can readily appreciate the desirability of an abundance of infective material.

Although it is preferable to employ bred mosquitoes, no serious objection can be made to the use of wild collected adults if it is reasonably certain that they inhabit a malaria free locality. The rare finding of an indigenous strain of plasmodium in any captured anopheline found in a temperate zone like that offered in the non-malarious districts of Great Britain or the United States should not preclude the use of this supply if serious difficulties are encountered in the collecting of more suitable material. However, the English workers are the only ones I am acquainted with who regularly employ uncultivated mosquitoes. While beginning our work in Columbia we found it useful to employ captured anophelines, but we soon exhausted the supply and found it more advantageous to permit the captured females to multiply. It is not a difficult matter to remove the eggs laid overnight and with suitable food the larvae develop quite normally in the shallow trays to the pupa stage. Of course one must be on the alert and bag the pupae before they become a winged domestic pest. The procedure here is to separate the pupae daily, placing them in shallow saucers surmounted by netted globes.

In general both high temperatures and high relative humidity favor development of the mosquito and the parasite it harbors. But the production of fungi and bacteria are also favored. These are principally saprophytic and tend to inhibit full functioning.

We have concluded that the optimum temperature and likewise the optimum relative humidity for maintenance may be placed arbitrarily at 70 to 75° F. and 60 to 75 as the percentage of humidity. When it is advantageous to accelerate the development of individual specimens for test purposes the temperature and humidity may be heightened. Then a proper incubator is essential. On the other hand, if maximum longevity of the product is sought the lowest temperature and relative humidity permissible are advantageous.

The method formerly employed of collecting large numbers of nondescript larvae and pupae from natural waterways has the disadvantage that the larvae cannot be dissociated from the larvae from accompanying predatory forms which are collected unavoidably, either in the egg form or more advanced stages. Here much loss unconsciously results. Then also there is the bother of either identifying each larva or awaiting emergence of the winged insect before one recognizes the species actually present. The advantage offered is possible saving of time when a small batch of insects is required for immediate use. All of this, of course, relates to a district reasonably well stocked at the proper season.

Probably the greatest difficulty one encounters in maintaining an all year round service station for malaria therapy is the paucity of material during the dormant season. One must store a reserve stock of material during the fall to anticipate the winter requirement.

Where one is equipped with a sub-tropical insectary the winter period presents no problem, as an open season for mosquitoes is perennial. Otherwise in the ordinary conservation of material a substantial cold chamber is an important adjunct. Mosquitoes can be stored unfed for six weeks to two months at temperatures averaging 50° F. Another means may be available and that is the conservation of anopheline eggs at lowered temperatures. We have found it possible to store eggs in a cold chamber provided at the Columbia institution at temperatures ranging from 38 to 42° F.

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*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Sixth Annual Meeting, Birmingham, Alabama, November 15-18, 1932.

**Special Expert, U. S. Public Health Service.

in a healthy unhatched condition for periods of five or even weeks At the termination of this period when exposed to the living room temperature of 74 to 76 F they were observed to hatch in never less than three days and develop into apparently normal anopheline mosquitoes Incidentally while experimenting with the temperature necessary to conserve the egg stage a range of temperatures from 48 to [illegible] F was found unfavorable inasmuch as these temperatures did not inhibit protracted incubation The eggs appeared to hatch within five days when subjected to these conditions

A more satisfactory though slow criterion of viability of the gametocyte is the appearance on the second or third day of the zygote on the gut wall of a test mosquito Of course this is not infallible because a change in the patient's blood may occur in the interim of awaiting the appearance of the initial pigmented forms in the mosquito

It has been my experience that in judging the optimum conditions for the insect carrier multiple infective feedings are decidedly advantageous up to six bitings We have applied mosquitoes in many instances up to 12 times but the disadvantages are judged to be too numerous chiefly the rapid contamination due to the bacteria and fungi the agitation necessitated by too frequent handling causing enfeeblement and last the important consideration of repeated discharging of accumulating sporozoites into the carrier patient causing reinfection the value of which is questionable

One often encounters the optimistic report that certain strains of malaria both tertian and quartan may however be lacking in gametocyte formation that artificially induced malaria cannot be transmitted by the mosquito This must be given the consideration it deserves It is admittedly not an easy matter to produce a batch of vigorous mosquitoes maintaining them for an unlimited period in a state of infectability but we have met with partial success after inducing anopheline mosquitoes of four American species to engorge themselves with the blood of artificially inoculated plasmodia However workers agree that there are good infectors and poor infectors as Colonel S P Jones has indicated and what the criteria are nevertheless is also to ascertain For example the test is recommended that blood from a suitable carrier (good infector) produces exflagellation beginning of conjugation observed in drawn blood in the presence of optimum vasmith and moisture Darling's dictum the presence in blood of an average of one gametocyte to 500 leucocytes is not applicable to other types of malaria particularly the benign tertian because one may obtain infected mosquitoes when the phenomenon of exflagellation cannot be demonstrated Mosquitoes may fail to carry on the plasmodium life cycle in the presence of numerous developed gametocytes and have been proven to exhibit infectivity in the presence of as few as one gametocyte to 1 100 leucocytes For example in early attempts with naturally induced malaria I had not succeeded in producing a single infected mosquito with a presumably good crescent carrier malignant tertian using a total of 219 anophelines and recently a series of 338 specimens failed to infect with quartan malaria when applied on various occasions to as many as [illegible] supposedly suitable cases when as many as 12 bites were given several of these anophelines

Not many investigators believe that induced malaria takes on all the characteristics of the natural disease Certainly it reacts differently to specific treatment and exhibits important parasitological characters at variance with the indigenous strain For example one observes particularly with quartan malaria an extraordinary degree of phagocytosis sufficient to tempt one to wonder if this phase does not contribute in some measure to the difficulty in infecting mosquitoes Again one observes in the tertian species the tendency for early gametocyte production It is quite common to observe half to full grown gametocytes upon the initial appearance of parasites in the patient's blood Also it is possible that one can infect mosquitoes earlier For instance we infected a batch of mosquitoes from the blood of a patient upon the second day of parasite appearance

In the induction of malaria the two methods in vogue blood transfusion and mosquito bite may well supplement each other It is customary before a strain of malaria parasites can be established in an institution where the principal mode is intended to be by mosquito application to obtain a supply of blood and inject it into a patient selected for malaria therapy Thorough microscopical tests should be made before the strain is adopted One is continually confronted with the possible presence of a mixed infection from a new source Also it is not uncommon for an old infection latent in the patient to flare up as a result of a few paroxysms accompanying the induced strain Two such instances have occurred in my limited experience In these mosquitoes had been used at different times to convey a vivax strain After about six paroxysms, the microscope revealed the presence of asexual forms of the malignant tertian parasites Interesting to relate the virulent or autumn predominated and in one instance superseded the vivax forms completely death supervened The obvious moral the microscope should be resorted to more frequently

The syphilologist remind us of the danger of disseminating neurotropic strains of the pallida organism when blood is transferred from one paretic to another The malariologist warns us of the possibility of transmitting mixed strains of plasmodia The pathologist reminds us of the occurrence of pathogenic streptococci or other forms of bacteria in blood used for malaria transference the clinician of the occasional anaphylactic shock accompanying the intravenous method of blood transfer We are cautioned to avoid these disturbances by utilization of blood from reservoir hosts who are non syphilitic donors by employing properly grouped matched blood and last the natural method of induction through the mosquito

Employment of the mosquito in malaria therapy unfortunately take this method out of the hands of the

clinician and places it under the supervision of the trained biologist. At the present time even the skilled clinician fails to understand why the feeding jar should not be violently agitated in an effort to accelerate the parasitism of the infecting insect; why the jar containing the mosquito removed to the hospital from the portable refrigerator should not be placed on the convenient hot radiator to arouse it from its seeming frigidity; why the operator should not place a dozen or more of the small feeding jars against the convenient anatomy of the willing or unwilling insane patient and impatiently anticipate the immediate attack of the presumably starved blood sucker. So we shall have to call on the trained worker who can elicit the proper cooperation of both host and parasite in the onerous task of malaria transmission by the bite of the mosquito. An objection offered to the application of the insect vector is the reported greater tendency of relapsing, that fully 50 per cent of patients acquiring malaria in this manner suffer a recurrence in the course of two years after the termination of treatment. The question arises if this relapse is not a blessing in disguise, acquiring a certain advantage as a supplementary spirochetocide.

Admittedly the trained biologist adds to the cost of treatment. However, his work is definitely a special job. The new investigation involving the use and preservation of the insect's gland sporozoites still claims the assistance of specially trained personnel.

The obvious advantage of employing mosquitoes is their portability and also carrying over the maintained virus for long period when blood is unavailable.

The matter of viability and resistance of the sporozoites in the mosquito is engaging our attention at present on account of the possibility of using sporozoites in suspension in various media and thus obviating the difficulty of carrying live mosquitoes from place to place. This work has been inaugurated in the South Carolina State Hospital and for the first time we have been successful in producing malaria by inoculating patients with sporozoites in citrate suspension.

Up to the present time we have tried out preservation of sporozoites with a variety of sugar, glycerin, citrate and ordinary physiological salt solution, and find that the sporozoites, however resistant in the mosquito, are easily destroyed *in vitro* when in contact with these reagents. It may be pointed out that sporozoites persist in a mosquito long after its death, and we have recovered sporozoites from dead mosquitoes fully 48 hours—more recently 65 hours—after the insect has died. Also we have shown that in the mosquito, though it may be killed by heat at a temperature of about 43 to 45° C., the sporozoites on dissection show viability. We have seen that to kill the sporozoites it is necessary to apply heat very close to 50° C. (122° F.).

DISCUSSION *(Abstract)*

Dr. L. L. Williams, Jr., U.S.P.H.S., Washington, D. C.—Dr. Mayne has been carrying on biting experiments since 1915 and has made a large number of observations.

Only the larger psychiatric institutions have been able to keep alive a strain of malaria by transfer from patient to patient. The larger institutions from time to time have lost the malarial strain they were using in the therapy of paresis. Methods of resupplying such a lost strain and of supplying a strain to the smaller institutions would seem properly to constitute a field study. It was not known how long malarial blood can be stored and still remain infective. Malaria can be kept alive in an infected mosquito, but what are the best methods of prolonging the life of an infected insect, and is it possible to store sporozoites outside of the mosquito? When the mosquito is properly cared for and its life prolonged, how long will the infection remain? If the mosquito is to be the only storehouse for infection, how should mosquitoes be shipped and how used upon arrival? The large number of problems encountered in developing the service to hospitals can readily be seen. Such studies require a place where a constant malarial infection can be secured. When the method has become simplified and when a method of measuring the infectivity has been devised, then such a service as he has described would and doubtless will become a commercial activity.

Dr. Mayne has mentioned the public health aspect of releasing carriers into the general population. In years gone by malaria was prevalent in the United States from Canada to Mexico. In the Mississippi Valley it is now practically confined to that portion from the southern part of Missouri to Mexico. Malaria is no longer found in the North because conditions there render it impossible for the disease to maintain itself. Continuance of these conditions will, I believe, effectively prevent a return of malaria to the areas now free. With ease and rapidity of travel now prevailing, the relatively large number of malaria carriers from the infected portions of the South annually invade many areas of the North where malaria no longer prevails. If these carriers have been unable to renew the infection, surely there is little danger to be apprehended from the occasional paretic carrier who may be released from observation while still carrying the organism.

MINOR DRAINAGE IN THE DELTA SECTION OF MISSISSIPPI*

By NELSON H. RECTOR,**
Jackson, Miss.

Tremendous sums of money have been spent in this country and in other countries during the last hundred years in draining swamp, overflowed and tidal marsh lands due primarily to the increased demands for the products of agriculture. As this demand became greater the market value of the lands increased, and the potential value of the wet lands made their reclamation feasible.

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*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Twenty-Sixth Annual Meeting, Birmingham, Alabama, November 15-18, 1932.

**Sanitary Engineer.

In the last twenty years many large drainage districts have been established in the Yazoo Delta of the State of Mississippi particularly in the northern part and have effected the desiccation of many large swamps. Such districts however provide only the major drainage, that is, the principal outlet canals and levee. During the period of subsequent settlement and while the clearing of the woodland is under way the recently established population suffers severely from malaria fever. As the minor drainage is developed malaria tends to decline as a result of diminishing mosquito production.

In Bolivar County, Mississippi, with an area of 8 9 square miles 830 miles of major drainage canals were constructed from 1908 to 1930 at a cost of approximately three and a half million dollars and during that period the malaria morbidity rate has shown a marked decrease.

It is not intended to convey the idea that the reduction in this disease was due entirely to the amount of drainage that was executed during this period, as there were several contributing factors. A more extended use of screens has probably been one of the principal factors in effecting the reduction of malaria.

Professor George P. Pickels in his book entitled Drainage and Flood Control Engineering says: In 1905 95 million acres of wet swampy lands still existed in the United States and 4 400 000 acres of swamp land still exist in Mississippi. Professor Pickel also states that out of a total of 18 200 000 acres in farm land in Mississippi some 1 450 000 acres are not properly drained.

It has been recognized for a long time that drainage properly executed is an important factor in reducing the incidence of malaria, and for that reason health authorities are not only interested in promoting drainage but are even more interested in seeing that it is properly executed. The land owner at first may be interested only in the reclamation of lands that can be farmed, while the health department does the drainage of areas producing the malaria transmitting mosquito. However if agricultural drainage is extended to such an extent that no lowland are left undrained the aims of all will be satisfied.

A great mass of literature has been written and is available in regard to the correct way of constructing ditches for agricultural drainage, little consideration however has been given to making land drainage effective in reducing the mosquito population and thereby effecting a control of malaria. In too many instances the engineer has not realized that he has actually created conditions that have been responsible for an increase in the malaria incidence, when he could have materially aided the health workers had he known something of mosquito control.

Since April 1929 the Mississippi State Board of Health has had from one to four engineers in the field who have devoted their entire time to the promotion of minor drainage. By minor drainage is meant the secondary canals and ditches necessary to reclaim areas left undrained by the main canal. Each engineer has been assigned to two or three counties and he visits them in rotation, spending a week in each county. He works as an additional member of the staff and an integral part of each county health department and at all times keeps in close touch with the respective county health officers.

The program as worked out for these engineers is definitely designed to evade competition with the practicing engineers and it is believed that the program in the end will aid rather than injure the engineers. We arbitrarily limit ourselves to projects the cost of which does not exceed $1 500. When it is found that the project will cost more than this amount it is recommended that a practicing engineer be employed. In the first place it is rare indeed for the average planter to employ an engineer to lay out the small projects with which we are primarily concerned, and second our engineers have been able in several instances to assist practicing engineers in the formation of a drainage district.

Where a request comes into the office of a health department for assistance on a plantation or in a small municipality our engineer makes a preliminary survey of the area in question to ascertain if it seems reasonable that such a project might be successful. If so he proceeds to lay out the drainage ditches by running lines and taking levels over the proposed line of the ditch. He then furnishes the landowner with a grade sheet which indicates the depth of the ditch at each hundred foot station and also a cut from the top of the stake. As the planter knows little or nothing of ditch engineering an instruction sheet is also enclosed. This sheet indicates clearly how he can check his ditch at each hundred foot stake to determine when he has reached the proper depth.

In several instances it has been necessary for the engineer to supervise the construction of the ditch.

When we finish the survey our part is usually completed and the cost to the State Board of Health ends. The individual or town then takes steps to execute the drainage, hence the one directly benefited bears practically all the cost of putting in the ditch.

Our program is well adapted for a county health department. Practically 100 per cent of the planters interviewed during the last year approved of the program and it is rare indeed to find one that does not think the work worth while. In each of these counties there are many persons who call on us when they plan to do any drainage. The engineering work has often been an entering wedge for other activities of the county health department. Frequently planters ask for information in regard to the installation of the sanitary toilet and want to know the cost of screening tenant houses. In this way we have seen sanitary privies built and screens installed on plantation farm tenant homes where the planter first became interested in executing drainage. In the same way we have received some of our best prospects from members of the staff of the county health department. And I think one may say that here no activity of any county health depart-

clinician and places it under the supervision of the trained biologist. At the present time even the skilled clinician fails to understand why the feeding jar should not be violently agitated in an effort to accelerate the parasitism of the infecting insect; why the jar containing the mosquito removed in the hospital from the portable refrigerator should not be placed on the convenient hot radiator to arouse it from its seeming frigidity; why the operator should not place a dozen or more of the small feeding jars against the convenient anatomy of the willing or unwilling insane patient and impatiently anticipate the immediate attack of the presumably starved blood sucker. Now we shall have to call on the trained worker who can elicit the proper cooperation of both host and parasite in the onerous task of malaria transmission by the bite of the mosquito. An objection offered to the application of the insect vector is the reported greater tendency of relapsing, that fully 50 per cent of patients acquiring malaria in this manner suffer a recurrence in the course of two years after the termination of treatment. The question arises *if this relapse is not a blessing in* disguise acquiring a certain advantage as a supplementary spirochetocide.

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The obvious advantage of employing mosquitoes is their portability and also carrying over the maintained virus for long period when blood is unavailable.

The matter of viability and resistance of the sporozoites in the mosquito is engaging our attention at present on account of the possibility of using sporozoites in suspension in various media and thus obviating the difficulty of carrying live mosquitoes from place to place. This work has been inaugurated in the South Carolina State Hospital and for the first time we have been successful in producing malaria by inoculating patients with sporozoites in citrate suspension.

Up to the present time we have tried out preservation of sporozoites with a variety of sugars, glycerin, citrate and ordinary physiological salt solution, and find that the sporozoites however resistant in the mosquito is easily destroyed *in vitro* when in contact with these reagents. It may be pointed out that sporozoites persist in a mosquito long after its death and we have recovered sporozoites from dead mosquitoes fully *48 hours—more recently 65 hours—after* the insect has died. Also we have shown that in the mosquito though it may be killed by heat at a temperature of about 43 to 45° C. the sporozoites on dissection show viability. We have seen that to kill the sporozoites it is necessary to apply heat very close to 50° C. (122° F.).

DISCUSSION *(Abstract)*

Dr. L. L. Williams, Jr., U.S.P.H.S., Washington, D. C.—Dr. Mayne has been carrying on biting experiments since 1915 and has made a large number of observations.

Only the larger psychiatric institutions have been able to keep alive a strain of malaria by transfer from patient to patient. The larger institutions from time to time have lost the malarial strain they were using in the therapy of paresis. Methods of resupplying such a lost strain and of supplying a strain to the smaller institutions would seem properly to constitute a field study. It was not known how long malarial blood can be stored and still remain infective. Malaria can be kept alive in an infected mosquito, but what are the best methods of prolonging the life of an infected insect and is it possible to store sporozoites outside of the mosquito? When the mosquito is properly cared for and its life prolonged, how long will the infection remain? If the mosquito is to be the only storehouse for infection how should mosquitoes be shipped and how used upon arrival? The large number of problems encountered in developing the service to hospitals can readily be seen. Such studies require a place where a constant malarial infection can be secured. When the method has become simplified and when a method of measuring the infectivity has been devised, then such a service as he has described would and doubtless will become a commercial activity.

Dr. Mayne has mentioned the public health aspect of releasing carriers into the general population. In years gone by malaria was prevalent in the United States from Canada to Mexico. In the Mississippi Valley it is now practically confined to that portion from the southern part of Missouri to Mexico. Malaria is no longer found in the North because conditions there render it impossible for the disease to maintain itself. Continuance of these conditions will I believe effectively prevent a return of malaria to the areas now free. With ease and rapidity of travel now prevailing the relatively large number of malaria carriers from the infected portions of the South annually invade many areas of the North where malaria no longer prevails. If these carriers have been unable to renew the infection surely there is little danger to be apprehended from the occasional paretic carrier who may be released from observation while still carrying the organism.

MINOR DRAINAGE IN THE DELTA SECTION OF MISSISSIPPI*

By NELSON H. RECTOR,** Jackson, Miss.

Tremendous sums of money have been spent in this *country and in other countries during the last hundred* years in draining swamps, overflowed and tidal marsh lands due primarily to the increased demands for the products of agriculture. As the demand became greater the market value of the lands increased and the potential value of the wet lands made their reclamation feasible.

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Sixth Annual Meeting, Birmingham, Alabama, November [illegible] 18, 1931.

**State Sanitary Engineer.

in the near future so that the planter may benefit by *increased yields at lowered cost of production* Profitable results may be expected from the cultivation of virgin soil and the employment of labor healthy because of a greatly lowered malaria incidence due to reduction of the mosquito density resulting from the elimination of the area in which mosquitoes formerly bred

We are urging the planters to grow cotton and corn in the areas where they have been raising mosquitoes

Discussion follows paper of Mr Clarkson page 464

MALARIA CONTROL IN GEORGIA BY CONVICT LABOR*

By L M Clarkson **
Atlanta Ga

Forty eight years ago Lavaran e pressed the hypothesis that the mosquito might be the vector of malaria and thirty five years ago Sir Ronald Ross discovered the multiplication of malaria parasites in the stomach of the mosquito Prior to this period there were many fantastic theories relative to malaria transmission and method of malaria control After analyzing this hypothesis we cannot but place especial credence upon two fundamentals namely first that at least in most states the *Anopheles quadrimaculatus* is the chief if not the sole vector of malaria and second that quiescent ponded waters are preferential for propagation of the *Anopheles quadrimaculatus* These two basic facts provide a foundation for constructive malaria control and reduce an ancient vexatious problem to a simpler one applicable to drainage only of certain specific waters It makes no difference that quinine for hundreds of years has been held as a reliable specific for the disease It is prevention that we need more than we need cure And so we adopt as our slogan "A Ditch in Time Saves Quinine" With these modern fundamentals incriminating the *Anopheles quadrimaculatus* and defining its preferential habitat drainage of only such waters as are preferential for the quadrimaculatus becomes our definite problem *in malaria control today* If any malariologist health officer or sanitary engineer is asked to state the most effective the most permanent and consequently in the end the most economical method of malaria control the answer will be drainage Theoretically we all subscribe to malaria control by drainage but actually we are afraid of the cost We dare not ask the price of drainage yet we admit that it is indispensable There is not one among us who prefers rather than drainage such methods as quininization screening oiling or Paris green dusting though financial circumstances often force us to follow *the course of least resistance and recommend a substitute for drainage* We all admit that we have done beneficial work with other methods but we could have done better with drainage When a human life is in the balance a physician is certainly expected by both the patient and family to recommend the most *efficacious treatment regardless of cost* Why then should not the health officer practicing prevention state to the public that though quinine and certain other methods are beneficial he stands for prevention of the propagation of the insect regardless of cost This policy should be established a public health ethics *This policy should be the creed of both health officer* and sanitary engineer and should the National Malaria Committee adopt it the anopheline army would quickly request an armistice Such however may seem to you only extravagant idealism My prediction that some day the southern United States will be malaria free due to drainage may seem like the present day prophecy that Prosperity is just around the corner but it is within our power It behooves the National Malaria Committee to crystallize sentiment and to accelerate use of this method The question then is how can we reduce the cost of drainage to popularize the method and overcome economic difficulties When homes are being lost farms abandoned and taken for taxes agriculture is sinking further into the mire of debt business in distress and ten million men and women are asking for work and unable to find it how can it be done? Not by drainage districts when drainage bonds are not marketable and when farmers are unable to meet property assessments *Furthermore drainage districts are* more adaptable to agricultural reclamation Agricultural drainage and malaria drainage are very often extremely divergent in both plan and purpose Agricultural drainage is more general malaria drainage is more specific Why combine the two and assess one at the expense of the other? We do not deny the fact that agricultural drainage often reduces malaria nor that malaria drainage certainly benefits agriculture but each problem is too scientifically specific in itself for practical coordination Moreover ask anyone of experience with drainage districts and you will be convinced of the unpopularity of drainage districts Regardless of the success of certain drainage districts in the past the present value of farm property makes the cost of drainage districts prohibitive Now about selling the idea to the farmer of doing his own drainage! In this the writer has met with some success but admits failure to establish county wide drainage Others may have succeeded and they should be commended In Georgia rural drainage for malaria control until recently has been the most difficult of all public health problems to sell to the public and the problem has seemed insurmountable May I digress here with a brief account of urban malaria control in Georgia before describing our plan of rural malaria drainage by convicts?

It was not until the year 19 0 when a Division of Sanitary Engineering of the State Board of Health

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*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty Sixth Annual Meeting Birmingham Alabama November 15 18 1932

**Chief Division of Sanitary Engineering State Board of Health

ment is successful if it does not create more work for other divisions of the department.

The planter is also taught some of the habits of the mosquito. He can readily be made to see the reason why small ponds or swamps lying in close proximity to dwellings constitute a greater menace to the health of the plantation than larger swamps lying farther from the houses. A number of plantations have been seen where the incidence of malaria could have been markedly reduced by draining these small areas. By so doing we would have forced the female mosquito to make a longer flight from the pond where she was bred to the dwelling where she obtained her blood meal and would have to make the same trip returning to deposit her eggs. By thus forcing her to make longer flights we are increasing the hazards incident to the journey and as a result a larger percentage of adults will be killed. Keeping this one fact in mind will do much to reduce the malaria incidence.

Another important aspect of this service lies in securing the coordinated efforts of many diverse agencies. A drainage project even of minor character frequently involves the cooperation of the drainage district, levee board, highway department and the railroad authorities before it can be accomplished. In all cases where requested this has been effected.

In the Mississippi Delta the sixteenth section lands are designated as school land and the income from them goes to the maintenance of the school system. In many of these sections large areas remain undrained. However in several counties the county officials have made it possible for us to drain swamps on school lands by the use of county convicts. One such area in Leflore County has been ordered drained by the use of convicts. A ditch less than one half mile in length will drain a forty acre swamp which according to old inhabitants, has never been dry. This piece of work will constitute a distinct contribution to the public health of this community as approximately one hundred people live within flight range of the mosquitoes from this swamp. In addition to draining this swamp this ditch will constitute an outlet for several small ponds in the vicinity.

Mention should be made of another method in the control of mosquito propagation that has been used to advantage in several towns and cities. Several ponds in these towns have been eliminated by filling with municipal garbage and trash. The City of Greenwood, Mississippi, has completely filled a two acre pond by this method. This City estimates that there have been 50,000 truck loads of garbage and trash hauled into this pond during the last two years. Since it lies nearer the center of the City than the previous garbage dumps it can readily be seen that the City has been able to reduce the cost of hauling its waste and at the same time has transformed an unsightly pond into what will eventually be valuable building lots. At any rate an area of two acres which constituted a menace to public health has been abated and at no additional cost to the town.

The importance of having an engineer lay off the ditches in the Delta section of Mississippi is realized when one learns that the average slope in this section is approximately one foot to the mile. In several instances we have been forced to lay off ditches with a grade of six inches per mile.

When the fall is so slight planters or even experienced drainage men (engineers, if you please) cannot estimate the fall between two points lying one half mile or more apart with any degree of accuracy. In several instances planters have stated that they had lost from $25.00 to $300.00 by running their ditches by guess work. Now these same men call on us when they contemplate doing drainage.

The following table is a summary of the drainage work that has been completed in the Mississippi Delta for the period of April 1929 to October 31, 1932.

MINOR DRAINAGE WORK DONE IN THE MISSISSIPPI DELTA

Totals to Date

Number of plantations on which surveys were made	410
Number of plantations which have completed work	364
Total number of surveys	966
Total length of surveys (miles)	432.8
Total length new ditches installed (miles)	71.1
Total length each channeled (miles)	90.65
Total length put to grade (miles)	161.75
Length of tile laid (miles)	1.9
Total number of ponds filled	9
Culverts put to grade	31
Total acres reclaimed	12,519.85
Total cost of work	$33,857.38
Number of planters who have been personally interviewed and offered this service	1,443

It will be noted from the above summary that the length of tile laid during this period is relatively small. Much of the farm tile that was laid fifteen years ago has become completely clogged. Realizing that it is extremely difficult to lay tile in a section where the grades are so slight the health departments have not pushed this type of drainage.

TABLE OF COMPARATIVE COST

Year	Cost of Ditches per Mile	Cost of Drainage per Acre
1929	$931.65	$14.71
1930	364.02	8.43
1931	205.43	2.01
1932	38.64	0.47

It will be noted in the above table that the cost of executing this work has steadily decreased since 1929. This fact can be readily explained as the ditches now are much smaller than those installed in 1929 and the cost of the labor and material has been greatly reduced. During the last year the greater part of the ditches have been installed at an exceedingly small cost, much of this work has been executed with labor which worked for either its food or its food plus a small money wage. The ditches cost nothing on several projects that were recently completed, due to the fact that the county loaned its road equipment to the planters.

It is confidently hoped that with a continuation of the present program much of the land that is lying out in swamps and bayous will be completely drained

drainage or approximately 28 miles was constructed by machinery. Due to considerable variation of drainage conditions drainage machinery is very desirable in certain counties, especially where large cross section excavation is necessary. Major drainage first by machinery providing a canal system for lateral minor malaria drainage is the general routine in certain counties. County officials are becoming more interested in purchasing drainage machinery. Drag line equipment is valuable for road construction purposes and when a drag line is not being used for this purpose it is convenient to use it for malaria drainage.

Dynamite drainage may be mentioned as another phase of malaria drainage which we have promoted to quite an extent. In addition to the 25 counties above mentioned there have been quite a few dynamite drainage projects scattered throughout the State. One project surveyed and started within the past month involves about 7 or 8 miles of canal constructed by the use of parallel rows of dynamite and requiring about one and one quarter pounds of dynamite to the lineal foot. Work of this nature is very spectacular and is very valuable in creating publicity and interest in malaria drainage. We usually have the newspapers take photographs of the dynamite explosion. These photographic newspaper illustrations are valuable for publicity data.

Briefly stated the plan of promotion of such work involves meetings with county commissioners at regular or called meetings. In telling the plan the point is stressed that we are not asking for money, only for labor; also that engineers will be furnished by the State Department of Public Health to make malaria investigation followed by drainage survey. Upon completion by the engineer of his profile grade shown in specified cuts stakes are driven at intervals and a work order sheet gives the foreman outline specifications for the ditches. During construction the project is visited by the engineer to insure satisfactory work. The number of convicts to be used in a county is generally left to the convenience of the individual county. Generally a minimum gang is about 6. We encourage the use of 15 or 20.

It might be of some interest to state that during this past summer there were about 1[illegible] towns and cities and also a few counties which used unemployed persons for malaria drainage. One of our Georgia counties together with the county seat provided approximately 5,000 man days of ten hours for the unemployed. In doing intermittent work was provided for hundreds of heads of families, but many men and children who otherwise would have been objects of charity. This, of course, was a dual service to humanity. It relieved physical suffering and destitution by creating work and it relieved physical suffering and economic loss due to disease.

Now as to the cost of drainage by convict labor. Our engineers in planning drainage systems depart from general engineering practice by not making estimates of cost. In fact, we avoid discussing cost of drainage in monetary terms. We prefer to speak of cost of drainage projects in terms of man days. From the actual selling of the idea of the use of convicts for malaria drainage to turning the projects over for construction we avoid using any terms involving estimates of cost or monetary cost values. It would be a grave psychological error. We attempt to impress the public with the statement, "Malaria control does not cost money but cost labor." Such a slogan is to our malaria campaign what yeast is to bread and as ethyl is to gasoline. The actual selling of this plan to county officials has its humorous aspects. We know that people are naturally suspicious of any plan asserted to cost no money. Often after this point of no cost has been stressed county officials go into executive session and we are called in to satisfy a contention that we forgot to state just how much money it would be necessary for the county to appropriate.

In the promotion of this work we are particularly careful as we go forward to build our bridges before us. We have learned from experience that if once county officials commit themselves in opposition we must count that county lost. No county official desires a reputation for vacillation. Conversely they desire it known that a decision once made is final and not to be prevented again. Consequently we must first load our guns in order to drive through the lines of opposition. Then it is necessary to build public sentiment so that county officials are actually sold on the plan before it is up for official approval. After this, if loss of interest is apparent, property owners must be persuaded to attend meetings of county officials requesting drainage on their individual properties. It is also particularly noted that just as individuals are each county is a problem unto itself. Tact, diplomacy and perseverance must be practiced to the utmost. Local newspapers must create and maintain public sentiment. County officials themselves must be malarially educated and their interest maintained. And above all they must have respect for and confidence in the public health personnel with which they come in contact.

Finally, allow me to say that in general we have made only a modest beginning. Of approximately 75 very malarious counties in Georgia the work is yet limited to 25, or only one third. At the present rate of progress let us hope that if we make the job too long posterity may carry on and eventually make Georgia a more healthful state in which to live.

It is the consensus of opinion of the National Malaria Committee that this plan has value. I wish to urge that its influence be brought to bear in order that the southern United States may at least partially relieve this great economic loss due to malaria by the least expensive and most logical method, thereby converting crime into benevolence.

In conclusion we have spent millions to eradicate the fruit fly in Florida, hundreds of thousands to eliminate the cattle tick in Georgia and Florida. The farmers in the cotton belt are spending hundreds of thousands to control the boll weevil and yet cotton sells for less than the cost of production. But what are we spending to eliminate the mosquito? Comparatively

was established that urban drainage for malaria control was systematically established under State Board of Health supervision. At this time malaria was certainly a very serious public health problem in towns and cities. The initiation and carrying forward of this work depended upon the efforts of a sanitary engineer periodically to visit the towns and cities for malaria investigations. Public interest was stimulated, local personnel was trained and supervision of drainage and other methods of control became important functions of the Division of Sanitary Engineering in towns and cities. Twelve years of urban malaria control in Georgia has reduced our urban problem to a minimum, leaving rural and community malaria still an extremely serious public health problem.

In view of only recent inception of rural malaria control we prefer to look with confidence to the future rather than to claim accomplishments of the past. We at least take cognizance of the fact that there can be no controversy over the most effective method and that is prevention of propagation of the insect. This method has been established in Georgia and we believe it will remain incontrovertible. No inference is made, however, that other states have not practiced and are not now practicing effective malaria control by various methods. As an ideal we would prefer to combine with drainage methods practiced in other states.

You recall the old axiom, "Necessity is the mother of invention." On this principle was built the foundation of our present malaria control program in Georgia. We were challenged to meet a public health emergency. We accepted the challenge and the public is receiving considerable benefit.

In 1929 in our malarious section and at an unpropitious season there was an exceptionally heavy rainfall. The result was a great surplus of residual surface water. Nature failed to endow this section with proper provision for rainfall run-off. By such geophysical failure this section is interspersed with physical depressions locally termed lime sinks. These depressions which hold residual rainfall are by their very nature preferential habitats for *Anopheles quadrimaculatus*. Fortunately, however, most of these depressions are adaptable to drainage. A graphic curve of annual rainfall coincides with remarkable consistency with malaria mortality and malaria epidemicity. The malaria control method then necessary is satisfactory drainage to permit more rapid rainfall run-off. Physically the problem is not difficult. Financially it is extremely difficult. That year with malaria deaths by counties running into the thirties and forties and malaria cases by counties running into the thousands, public sentiment for state malaria control action was aroused. Demands for relief were made by the public. The prestige of state public health was in the balance. Consequently it devolved upon the State Department of Public Health to discover methods and means to alleviate this rural crisis. We met with county boards of health and county commissioners to discuss the problem. Neither counties nor state had finances for malaria drainage. We may express this inconsistency thus: Million for highways but not one cent for sickness, which evidently was the parent of our thought. Monetarily we are poverty stricken but in labor we are rich. With conviction of the practicality of the use of convicts for malaria drainage our next problem was to sell the idea to county officials. The chief difficulty encountered was that convicts had never been used for such work and it was generally believed to be illegal. This contention was met with wherever an attempt was made to promote the plan. It then became necessary to obtain a written decision from the Attorney General relative to the question. His decision was that "Convicts could be used in Georgia on any type of public works not in competition with free labor." Of course due to lack of money there was no possibility of using free labor for malaria drainage so it could not compete with free labor. Furthermore the use of convicts for highway work is in fact more in competition with free labor than their use for malaria drainage. So this obstacle was removed.

Convicts had been used in possibly two or three counties on reclamation drainage and possibly to some extent for minor drainage around towns and cities. This discussion outlines only general rural hand labor drainage specifically by convicts for rural malaria control in counties and its establishment as a general policy throughout the State.

Establishing the first county under this plan was fraught with difficulties. It not only involved selling the idea to county officials but to the general public also. Long experience has taught us that county officials are extremely hesitant in diverting to any extent from a long existing narrow routine without public demand. Consequently the desire of the public must be manifested or an appeal to county commissioners will be of no avail. When sufficiently interested, county voters can exert a mighty influence. When people suffer from a preventable disease and yet a county's potential wealth is in its convict labor there is no room for compromise. In promoting this plan we continuously expounded one fundamental truth, namely, "Malaria control does not cost money. It costs labor." Consequently even in the poorest county if the county has a potential wealth of convict labor there is no excuse for additional economic loss, mental anguish and physical suffering. This was our appeal in initiating the use of county convicts for malaria drainage. This plan was finally accepted by one intrepid county with the result that soon the second county ventured, then the third, and today there are 25 counties in Georgia using convicts and road machinery for malaria drainage. In 1931 314 ponds were drained comprising approximately 10,000 acres, necessitating about 135 miles of ditches and canals. In 1932 occurred the first full year's operation under two district sanitary engineers furnishing engineering assistance to the counties. Totals for 1932 will exceed those for 1931.

An interesting item in connection with the general plan is that 7 of these 25 counties are now making use of drainage machinery, that is, drag line dredge and steam shovel. During last year 14,569 lineal feet of

Mr Clarkson has indicated in detail how to proceed in a state where it was thought not legal to use convict labor for eliminating sources of anopheles in rural areas

Under such conditions which by the way are similar to those of a dozen other states he has succeeded in a relatively short time in inducing the county commissioners of one third of the malarious counties of the State to carry on drainage operations and to continue them at this time when the health workers of most of the states of our malaria belt are busy wondering how they can get any work at all under way

This mode of procedure has been brought up to my knowledge at two of our previous annual meetings and yet it is probable that Mr Clarkson through his personal interest and effort has accomplished more along this line than all other offices in charge of state malaria control activities put together

Mr W Z Barr Little Rock Ark—In Arkansas we are recommending to all of our counties requesting R F C aid to relieve unemployment that they list among needed and useful projects drainage in connection with malaria control Such projects are admirably suited to R F C aid in that no material is required and that they can be instituted in the more densely settled rural sections where unemployment relief is most needed It is realized that many drainage projects will no doubt go forward without adequate engineering study and consequently some degree of effectiveness will no doubt be lost The general plan however of reviving interest in drainage for malaria control is certainly justified The delta section of Arkansas has a great number of drainage districts the largest of which include very large canals These large ditches were originally planned to remove the excess overflow and since they are generally laid on extremely flat grades they practically serve for storing small amounts of water during the entire mosquito breeding season as the result of which they are undoubtedly responsible for a great amount of mosquito breeding and malaria Much could be done to relieve this condition by more effective maintenance which should comprise removal of debris and regrading of the bottoms of the channels in order to secure drying up of the ditches We are also recommending such projects in connection with R F C relief funds

While economic conditions for the past few years have made it impractical for Arkansas to finance even minor drainage projects it is hoped that more of this work will be done as a result of the stimulus given it through efforts to relieve unemployment

Georgia has given us an excellent demonstration of what can be done with convict labor and I am sure that many counties throughout the South could put into effective operation a similar program In Arkansas the number of county convicts available for such service in most of our counties would be too small to carry out such a program satisfactorily There are a number however which I am sure could use it advantageously

This is certainly a proper time to stress the need for drainage in connection with malaria control as well as more effective maintenance in existing drainage districts from the standpoint of malaria prevention

IMPROVED RURAL HOUSING AS A FACTOR IN MALARIA CONTROL*

By HOWARD R FULLERTON C E **

and

E L BISHOP M D †

Nashville Tenn

Although generally the rural home is constructed after quite simple plans very often because of improper planning the house provides inadequate protection against the rigors of both summer and winter Generally it receives too little attention as regards home conveniences sanitary facilities the selection of a site and the natural beauty of the landscape and frequently it lacks the essential safeguards against the insect borne diseases such as malaria

With proper home and community planning rural people may enjoy most of the housing comforts which are provided in the average home in a city

The Tennessee Department of Public Health has become concerned with the problem of housing and house planning for tenant farmers principally in an effort to combat malaria in the rural population However the objective has been not only to insure protection against the mosquitoes which transmit malaria but also to provide essentials of home construction which guarantee maximum comfort in summer and winter afford convenient arrangement of rooms and allow economical cost of construction The study has involved not only details of construction and plans for the individual home but also scientific grouping of homes and community planning The latter has been practiced for years in certain European countries but has received little attention in the United States particularly from the point of view of malaria control

This discussion will refer to some of the details of house and community planning which are believed to be of particular importance in the control of rural malaria and which with a limited amount of promotional and technical service from state and local health departments can be provided by the average farm owner at little or no additional cost

At present great numbers of farm houses especially tenant houses are built on sites entirely unsuited for the situation of dwellings The practice is quite common to place tenant houses on plots which cannot be used for cultivation of crops due to such circumstances as sterility of the soil and improper drainage The latter condition obviously is of tremendous importance as a malaria problem

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*Read before the National Malaria Committee (Conference on Malaria), meeting jointly with the Southern Medical Association Twenty Seventh Annual Meeting Birmingham Alabama November 15-18 1933

**Sanitary Engineer Division of Preventable Diseases

†Commissioner of Health

nothing Are citrus fruits farm commodities and animals of more importance than human beings? Our indifference answers this question Let us make concerted effort to put our quinine money into drainage Thus we can eliminate that line on the map below which capitalists regard as undesirable for establishing of industries and building of cities It is then that we shall collect great dividends from small investments in public health

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DISCUSSION (*Abstract*)

Paper of Mr Rector and Mr Clarkson

Mr J A LePrince USPHS Memphis Tenn—In several counties toward the northern end of our present malaria belt the practicing physicians have recently informed me that malaria prevalence among the farming population has been higher this year (1932) than in 1931

Mr Rector brought out the fact that the land owners in one county in Mississippi spent about $4 216 per mile for major drainage ditches, or about an average of $159 000 per year for 22 consecutive years or [illegible].54 per acre under cultivation to date plus maintenance charge In the same period the total spent by the same county for maintenance of public health work was from 1920 to 1930 both inclusive about $102 000

This clearly indicates that the representatives of the banks which sold the drainage bonds can sell their product to the public more rapidly and effectively than we can sell public health to them and indicates the real importance of our spending more time more money and more mental activity in learning how to sell our product

The engineering divisions should see to it that every engineer who graduates from the technical schools of the State is taught that it is his duty to reduce malaria in connection with engineering construction operations The American agencies employing American engineers in the countries to the south of us are yet losing large sums annually in engineering construction operations because of lack of adequate instruction in our American technical school

In connection with the impounding of water of rivers for hydro-electric development we can not expect those in charge of construction and maintenance operations to know as much of the details of control measures as we ourselves know Where those in charge are ready and willing to follow the advice instructions and requirements of the state health department the desired absence of Anopheles production can and will be achieved provided the state health officials give the working field forces the necessary information and field instruction However if it happens that from shortage of funds of field instructor or for other reason any state board of health of our malaria belt is unable to give adequate supervisory assistance to projects sadly in need of it then who is to be held responsible for the explosive malaria outbreak that generally accompanies these conditions?

Regarding the *creation of garbage dumps* as a means of reducing municipal garbage disposal expenses there is a wrong way and a best way to carry on It is natural for any public works section of a city or town to build high dumps and raise flies and rats galore and take twice as long as necessary to fill the sources of Anopheles

So far as malaria control is *concerned* a *dump two* to three feet above high water level is just as good as one 10 to 20 feet high and is generally less of a nuisance If *ground* area is *limited* the *dump* can be built rapidly in layers At Panama we fenced in the dumps (barb wire fences) and prayed the fresh dump surface with thinned watery fermented molasses (over 3 per cent) treated with arsenic We had very little *fly nuisance* at the dump and have reason to think the dump acted as a fly collector for the surrounding district The flies received a deadly jag

In draining at Panama we had some zero grades to tackle and slid by the difficulty in territory near toe hills by (a) connecting tile lines with a branch tile line under pressure fed by ditch or streams higher up and (b) by inserting wooden lift gates in drainage beds to flush flat creek bottoms and to drown anopheles larvae therein A native of Holland was told You cannot make water run up hill and he replied Maybe not but I can build a cheap windmill out of waste material which can and will so what is the *difference?*

In much of our flat territory we can use small centrifugal pumps to advantage to spread the water over the parched hot land (band pump gasoline driven pump on truck or use jacked up Ford wheel to give us power) and then the water will not try to run up hill but *will aviate and the Anopheles crop will not mature*

We can use improvised strainers through which to lead water into sumps where the cost of clearing the sumps of silt and debris would run too high

In territory similar to that in which Mr Rector is operating it so happened that nature placed willow trees on the banks so that they shaded the bed of the narrow bayou (or watercourse) in such a manner as to prevent young willows from growing in the bed of the bayou Elsewhere along the same bayou there was heavy silting going on (caused by the growing up of young willows) There seems to be an indication that willows can be used or grown so as to stop more willows from growing and should this prove to be a practical thing to do in many localities the saving in cost of agricultural ditch maintenance will be sufficient to pay for operation of the county unit as well as other necessary public activities

It was noted by U S Public Health Service workers as far back as 1914 and often since then elsewhere that in North and South Carolina and Georgia in those sections of narrow deep ditches which were shaded by wild honeysuckle growing over the top of the ditch Anopheles production did not occur though all along the same ditch up to where the natural shading began *and all along its course from where the shading terminated* larvae of anopheles were easy to obtain

Of course it is not the willow tree itself that may be used to stop other willows growing in our flat bottom and wide agricultural ditches but it is the shade it gives that brings the desired results when the willows are so spaced and situated as to produce a maximum of light shade on the area where we desire to prevent growth It is quite possible that other quick growing trees of good shading qualities properly spaced and properly situated with regard to the edge of the ditch will give as satisfactory or better results

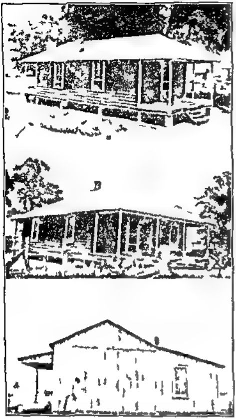

Fig 3 Top Fig 4 Center Fig 5 Bottom

After a selection of location and types of houses has been made by the land owner working drawings, bills of material and general specifications for the house are available to him through the local health department

The more important recommendations which are included in the bulletin are as follows

(1) Proper location of the houses in scientific groups rather than the isolated single dwellings scattered over the plantation in haphazard place

(2) Underpinning of concrete or other material which will not rot and ventilation of the space under the floor

(3) The use of standard lengths and widths of lumber and other materials to facilitate their purchase in a small town and to minimize waste

(4) Construction of floors of good tongue and groove wood flooring free from knots. We do not believe that land owners will spend the additional money for a sub floor

(5) Inclusion of a closet in each bedroom and a pantry arrangement in each kitchen

(6) Standard sizes of doors and windows for every house

(7) Screens of sixteen mesh for doors, windows and all other openings

(8) Finish of inside walls and ceilings Sheet rock or a plaster board of any brand can be used This board is economical can be sawed to fit perfectly can be painted papered or left natural Tenants cannot use this board for fuel as it is non inflammable Other finishing materials are plaster or three-eighths inch ceiling boards

(9) Each house should be weather boarded

(10) Each house should have an economical and substantial roof Composition roofing can be purchased considerably cheaper than most any type of

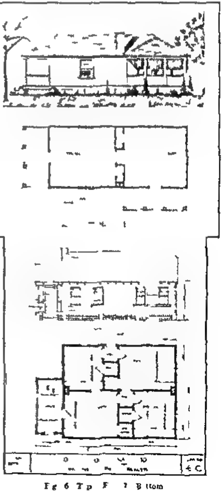

Fig 6 Top F ? Bottom

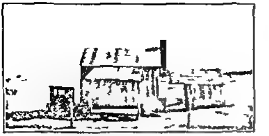

Fig. 1

Figure 1 shows a three-room tenant house representative of a large number of houses in the lowlands of Western Tennessee, both in type of construction and nature of location. It is situated quite near a slough; it is practically surrounded by water after every rain and is damp almost continuously during the rainy season. It is one of several tenant houses scattered over a large farm, but with a minimum amount of forethought and planning on the part of the farm owner a site could have been chosen more satisfactory from the point of view of convenience and sanitation and at no additional cost.

While the selection of home sites is of great significance, equally important are details of house construction. The items of faulty construction which are most commonly found in tenant homes may be enumerated as follows:

(1) Wood underpinning which rots and permits the house to sag.

(2) The house so near the ground that it is damp during practically the entire rainy season.

(3) Floors of plank boards which shrink, causing openings which permit the ingress of mosquitoes and other insects.

(4) Outside walls of the box type where the outside slats after a time always become warped, often break and are of little value.

(5) Ceilings of rough lumber and thereby not mosquito-proof. This is of particular significance in that the mosquitoes may pass through the cracks and find a dark harbor in the attic during the day and return by way of the same route to the room at night.

(6) Roofs, at least over a part of the house, too flat, thereby conducive to rotting of the roofing material and leaking of rain.

(7) Use of metal roofs and lack of end ventilation of the gable which increases the temperature of the house in summer to a very high degree.

(8) An entire lack of appreciation of attractiveness in design.

Figure 2 shows a house which is representative of a large number of tenant houses in Tennessee and which typifies most of the *faulty items of construction* mentioned above.

Of course the types of houses shown in *Figures 1* and *2* are not universal on tenant farms and for a

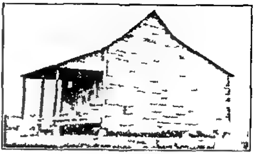

Fig. 2

number of years certain large land owners have recognized the economic importance of proper tenant house construction. Unfortunately, however, technical advice has not been sought with the result that in general the newer types of houses, although constructed from the point of view of bodily comfort and disease prevention, have not been entirely satisfactory. Practically no attention was paid to architectural attractiveness.

Figures 3, 4 and *5* show three tenant houses constructed in 1930 by a large land owner in Western Tennessee. The two-room houses were built at a cost of approximately two hundred twenty-five dollars ($225.00) each and the four-room house about four hundred twenty-five dollars ($425.00).

No one of the houses shown above is attractive in design. The roofs are of such construction and design as to make the houses excessively hot in summer and cold in winter. Ventilation is inadequate and in two of the houses the ceilings are too low. No closet space is provided in any of the houses and in each instance the chimney rests upon wooden brackets, thereby causing a fire hazard. The porch of each house or at least a part of it should have been properly screened to allow the residents to occupy it after nightfall under protection against the anophelene mosquito. Other defects will be noted from the foregoing figures, which, however, are of less significance. All of these houses could have been constructed so that their appearances would have been attractive, their interiors more convenient and their many defects eliminated with very little if any increase in cost.

The Tennessee Department of Public Health has developed a bulletin for general distribution which shows ten modern farm tenant houses ranging in size from two to five rooms and in estimated cost of construction from two hundred twenty-five ($225.00) to five hundred fifty ($550.00) dollars. The cover design of the bulletin shows a suggested plan of grouping houses into small communities.

The bulletin shows front views of the houses, floor plans and estimated costs of construction. It also *includes details relative to location, the lot, design, bids* and erection, and sanitation. The latter includes a detailed description of a properly constructed well and a sanitary privy.

MALARIA CONTROL IN ALABAMA IN 1932*

By J N Baker MD **
Montgomery Ala

Malaria control work in Alabama for the year 1932 has continued along the lines outlined in last year's report County health departments aided by a number of field men from the central office have continued to attack the problem wherever control work appeared feasible Economic conditions have materially affected actual construction in the form of drainage and screening Nevertheless the men's time in the field has been utilized to advantage in carrying out educational programs through use of the motion picture films and a total of 32 counties have been reached with programs of this kind

Early in the year work and study on a plan for drainage on a county wide basis was begun and facts and figures are being assembled for future use There is still a great deal of minor drainage which could be accomplished at relatively little cost Its handling on a county wide basis seems preferable Recent legislation provides for the use of convict labor in the construction or maintenance of projects incorporated under the drainage law

Control of impounded water remains a major activity The field work in this connection is being gradually shifted from the central organization to the county health departments Uniform observation of the regulations governing impounded water has been secured with no known epidemics occurring during 1932 In one instance an outbreak was probably averted by having an owner dewater early in the season and clear the basin before reimpoundage In another instance several measures were carried out to combat the possible danger resulting from an early season infestation of *Anopheles quadrimaculatus* Production was halted by lowering the water level of the pond and increasing larvicidal operations Transmission along the affected population was prevented by spraying houses daily and administering plasmochin for a period of thirty days The expense of these measures was borne by the company which also screened all unscreened houses in the affected area This particular project is an old one and is not subject to the regulations but illustrates the cooperation being secured in preventing malaria transmission around impounded water

During the year the director of malaria control on one impounded water project made material improvements in equipment for applying oil as a larvicide thus reducing costs and increasing the effectiveness of the work

A motion picture film dealing with malaria control on impounded water was completed by the department during the year It supplies a special need for a film of this type

Indications are that Alabama this year will have the lowest malaria death and case rate in its history We cannot claim that this comes as a result solely of our efforts as seasonal conditions have undoubtedly had much to do with the decrease since the peak occurring in 1929

The comparative morbidity reports for the state as a whole for the years 1929-1932 from January 1 to November 1 of each year are given as follows

Year	No Cases Reported
1929	9496
1930	4597
1931	2219
1932	2004

*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association Twenty-Sixth Annual Meeting Birmingham Alabama November 15-18 1932

**State Health Officer

MALARIA CONTROL IN ARKANSAS IN 1932*

By C W Garrison MD **
Little Rock Ark

Arkansas malaria control activities for 1932 comprised measures for mosquito prevention in 24 urban areas having a combined population of approximately 200 000 a greater increase in control activities in rural areas through mosquito proofing of homes and the administration of quinine Considerable educational work together with actual supervisory work has been carried on throughout the season by the county health personnel Activities carried on in the urban areas comprised no new methods although a new type of larvicide as a substitute for oil was tried out in a number of areas The data available in connection with the use of this larvicide is insufficient to permit of satisfactory conclusions This larvicide is a by product in the manufacture of alcohol out of hardwood in Crossett Arkansas It is a heavy acid oil that precipitates in water sweeping down the larvae

During the past six weeks the State Board of Health has cooperated with the state and county committees which administer funds granted by the Government Reconstruction Finance Corporation and has been successful in promoting minor drainage projects in connection with the unemployment relief activities It is felt that minor drainage for mosquito prevention is admirably adapted to the R F C relief activities in that no materials are required and that the need for the drainage is generally found in those more thickly settled rural sections where the problem of unemployment is acute We are planning to expand our drainage

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Sixth Annual Meeting Birmingham Alabama November 15-18 1932

**State Health Officer

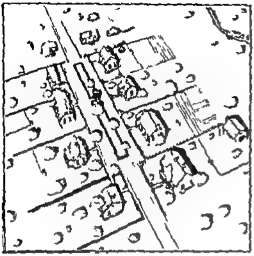

Fig 8

metal roof and is more resistant to heat and cold. The small additional cost of sheathing the entire roof is well warranted

(11) Exteriors of all houses should be painted with at least two coats of lead and oil paint or a good wood preservative This will add years of life to the house and also make it more attractive

Figures 6 and 7 show houses of two and four rooms respectively which provide the features recommended above and which can be contructed at estimated costs of two hundred twenty five ($225 00) and four hundred twenty-five dollars ($425 00) The costs of these houses are entirely within the range of those of houses shown in Figures 3 4 and 5

Perhaps the best method to insure that a house will be built according to the plans particularly where local carpenters are employed by the owner is to provide a bill of materials for each plan which specifies not only the amount of but also the exact use for each item of building material

If central water and sewerage disposal systems are not practical each house should be provided with a safe pump well located conveniently to the house and also a sanitary privy

There are many other features some of minor importance which should be included in the construction of a satisfactory farm tenant house but time will not permit a discussion of them in this paper

Community planning or grouping of tenant houses is believed to be of equal importance to individual house construction In the bulletins referred to above we have stressed the importance of scientific grouping of tenant houses and Figure 8 shows an aerial perspective which is used on the cover sheet of the bulletin

In area where it has been practiced community planning has been found to be profitable to both tenants and land owners

For the tenants an improved water supply proper sewage disposal and protection against malarial infected mosquitoes can be more easily and economically attained when the tenant houses are arranged in groups Thus community planning promotes a higher standard of hygiene public health and social welfare For the land owner the scientific planning and grouping of his tenant houses should be of economic value since it aids in the protection of the health of his employees thereby increasing their efficiency and productiveness Grouping also facilitates the inspection of his houses and direction of the work of his tenants Finally it should create among his tenants a pride in caring for their homes thereby resulting in a minimum of depreciation of the property

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DISCUSSION (*Abstract*)

Mr C C Kiker Montgomery Ala—The idea of house and community planning is not entirely new but this paper presents the subject in a new light and describes some very important steps which have been taken in a forward direction Efforts along this line must surely bear fruit with a reasonable and conscientious public

Proper home planning and construction drive at the root of much of the difficulty we are now encountering in mosquito proofing rural homes While it is possible to make a large percentage of the old houses mosquito proof the task is no easy one

A significant fact brought out by the paper is that houses of satisfactory construction can be built at very little additional cost over those improperly constructed This should certainly be of interest to the owner Were insect proof houses obtained at considerabe cost both in new and old construction the outlook would not be favorable But the additional cost of mosquito proofing in new construction is fractional and in houses already constructed it appears to be well within reach of the average tenant or owner

I am glad to know that one state department of health has taken the lead in the publication of plans for construction of rural homes This has been considered in Alabama but to date the work has not been undertaken

Mosquito proofing programs as an activity of a number of county health departments were initiated in Alabama some two years ago While we have not accomplished all that we hope to in the matter of actual construction no opportunity has been lost of furthering the educational feature of the program A marked tendency toward improved construction has been observed Builders at present appear to be giving more thought to making new houses insect proof In view of past practice this is encouraging and in the fact lies hope of securing eventually the most from improved housing in malaria control

CONTROL OF IMPOUNDED WATERS

Under a perm t y tem all water impounded in the State mu t meet requ rements for protection of the publ c from malaria caused b impound ng of waters for hydro electric wate power recreational and fishing purpo e The propo ed area must first be cl red of all vegetation and if in the malarious ect on of the State an approved larv cide together w th app oved equ pment for apply mu t meet pec fications of the Department of Publ c Health Any person firm corporation county or munic pality des ring to impound water mu t first submit plans and a de cription of the project The propo ed site is then investigated by a rep sentat ve of the D v on If approved a prelimi nary permit is granted to proceed with con truction This area then under con tant observation until sat isfactory work justifies rai ng of the water When clearing larvicide appl cation and equipment s satis factory a final maintenance permit is issued Below s data showing the extent of impounded water malaria control

N mber f hyd l t d l pm ts m t g m p d d t g l t 48
N mb f es hyd o-e t 1 0 0
N mb r f hyd el t d l pm ts u g l d f mosq to tr l 7
N mb of der lar l d t l 21 000

MALARIA CONTROL IN FLORIDA IN 1932*

By Henry Hanson M D **
Jacksonville Fla

The malaria c ntrol activit s in Florida ha e con i ted of a continuat on of an educat onal pr am stre ng the importance of protection aga t the Anopheles by screen ng and by th e mean mo qu to p oofing of the hou e Short rad us d ainage a well other practical drainage project ha e bee ad ocated and e tabl hed There ha recently been an arrange ment made by wh ch ome of the Recon truction Fi ance Corporation fund ha b en made a ailable for ditchin in a ea elected by the State Board of Health

Duri the summe a gener l ur e of the outhern po tion of the state was made by D s Mark F B yd and T H D Griffitt Mr C H B adley in ch ge of the Entomolog cal Station at Orlando Mr Louva G Lenert the Ch ef Eng eer of the State Boa d of Health and the State Health Officer This tour in cluded observations beginn ng H ll bo o County and from there on southward a ong the we t coa t as far as Fort Myers thence to the outhern tip of the penin sula and acro along the Tamiami T ail and from Miami as far south as Long Key *Anopheles quadri maculatus* were found as far as the Tamiami Trail Cruc ans were found as far outh as Homestead Be yond that po nt no Anopheles were observed The distr ct sanitary officers have made such surveys of Anopheles evalence as their dut es would allow gi ng a partial di tribution of b eedin

Among the pecial activities we have the Rockefel l Foundation wh ch is mainta ng a tation of Mala ria Re earch at Tallaha ee working under the d rect on of Dr Mark F Boyd largely on the rearing of Anopheles in a pecially prepared insectary and the inoculation of paretics with b n gn tertian malaria at the Ho p tal for the In ane at Chattahoochee Much aluable new data have been made availab e at this Stat on For other details reference is made to the publications of Drs Ma k F Boyd and W K Strat man Thomas

Supplementing the work cf the Malaria Research Station at Tallahassee the Surgeon Ge eral has detailed Dr T H D Griff tt to carry on field studies in malaria control Dr Griff tts has his office at the h adquarters of the State Board of Health and has embarked on a program of urveys w th the plan of se ecting two counties for special control studies Dr Griffitts is in cha ge of the Divi on of Malaria Control Studies of the State Board of H alth

Recently an a rang ment has been made with the Bureau of Entomology b which Dr W V King has been placed on our taff a con ultant n Ento mology

The work n all thr e divi on may be judged from the character of the per onnel in charge of the hi hest ch racter and we expect to develop a prog am of malaria control on the ba is of the findings of the thr e experts n que tion The work of the Malaria Re earch D vi io under Boyd s imm diate direc t on is the first e tabli h d and ha its p ogram more de eloped than the ther

MALARIA CONTROL IN LOUISIANA IN 1932*

By W T Browne M D **
New Orleans La

W th our hortage of funds a d the diffe ent mall flurr es of mallpox *et cetera* we were very fortunate in being able to ho v the following f gures

There has been a l ght ncrea in the number of cases of malaria reported in the State of Louisiana

19 0	1931	1932
1096	652	960

*R d bef N l M l C mm tt (C f M la) meet g jo ly th So th rn Medical Associa T S th A ual M t g B m gh m Alabama N mbe 15 18 1932

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**D ect r B M lar Mosq t Contr l State Board of Heal h

activities along with the unemployment relief work and particularly in rural area. While the amount of money spent on these projects is largely in proportion to the amount of effective drainage secured it is realized that the primary purpose of these projects is to aid in unemployment.

Owing to financial limitation it was found necessary greatly to curtail the mosquito proofing program begun in 1931. It is felt however that this work is very valuable and should be extended when economic conditions are more favorable.

The total number of malaria deaths reported for 1931 was 499 compared to the previous three year average of 742 representing a reduction of 33 per cent over the three year average or a death rate of 27 per 100,000.

MALARIA CONTROL IN GEORGIA IN 1932*

By L. M. Clarkson,**
Atlanta, Ga.

The year 1932 was the second full year of intensive promotion of urban and rural drainage principally by the use of county and state convicts for malaria drainage. The latter quarter of the year was marked by adding to convict labor certain forces classified under unemployment relief, city tax delinquents, city prisoners and regular city employees. Approximately 141 miles of new drainage was constructed and approximately 500 miles of maintenance or old drainage involving lighter work. There were 45 ponds comprising over 4,000 acres drained.

Attention may be called to the considerable increase of rainfall during 1932, yet there was but a slight increase of malaria deaths for this year. Even though there was an excess of rainfall for the year throughout the malarious counties the malaria deaths remained practically stationary. Because of its short duration too much credit should not be given to drainage.

An attempt was made during the year in two counties to obtain more accurately information relative to malaria incidence by means of blood examinations in all schools. Immediately after this information was obtained showing a very high rate of malaria infection one of these counties readily agreed to cooperate by assigning convicts for use on drainage. Drainage surveys are now in progress and actual construction will immediately follow. It is proposed to use these two counties as demonstration areas to measure results. This work is in cooperation with the Division of Epidemiology.

Several counties have obtained loans from the Reconstruction Finance Corporation and are using unemployed force for malaria drainage. It is anticipated that during this year work will be considerably augmented and many counties will take advantage of this means of unemployment relief and public health improvement.

CLASSIFICATION OF COUNTIES UNDER MALARIA DRAINAGE

It will be noted that there are 44 counties which have been rendered engineering service by drainage survey and drainage supervision. Some of these counties have practiced malaria control by the use of county or state convicts for both rural and urban drainage. Others have made use of miscellaneous labor chiefly in towns but in some instances for both urban and rural drainage.

Below are listed accredited and non-accredited counties. An accredited county is defined as follows: (a) official adoption of malaria control by county commissioners; (b) use of county or state convicts or other labor authorized by county officials; (c) plan intermittent or continuous consistent with agreement of county. A non-accredited county is one which has completed a project or projects without official assurance of continuous work.

Accredited Counties.—Appling, Ben Hill, Burke, Calhoun, Chatham, Colquitt, Decatur, Dodge, Dougherty, Irwin, Laurens, Meriwether, Miller, Mitchell, Montgomery, Richmond, Screven, Sumter, Thomas, Turner and Worth.

Non-Accredited Counties.—Bacon, Bryan, Bulloch, Candler, Coffee, Crisp, Dooly, Emanuel, Evans, Fulton, Glynn, Jenkins, Johnson, Lee, Liberty, Pulaski, Tattnall, Telfair, Tift, Treutlen, Washington, Ware and Wheeler.

It is interesting to note that as progress is made in establishing urban and rural drainage authorized by public officials the interest of individual property owners is also so stimulated that service from the Division is requested for malaria and drainage investigations. The fact that a pond either natural or artificial usually constitutes a malaria problem is being more generally recognized. This is a considerable aid to official establishment of county drainage.

MALARIA DRAINAGE BY DYNAMITE

A project worthy of mention is a very serious malaria problem in a valley 25 miles north of Atlanta. The problem involves several hundred families in an excellent agricultural territory. It is no exaggeration to state that the malaria problem has been so serious that families have moved from the county on account of it. The problem involves a drainage project of exceptional magnitude. After three years of effort by the Division the project was recently started. Portions of the drainageway have been improved by the use of dynamite. It is proposed during the current year to continue the work gradually completing the entire project.

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*Read before National Malaria Committee (Conference on Malaria), meeting conjointly with the Southern Medical Association, Twenty-Sixth Annual Meeting, Birmingham, Alabama, November 15-18, 1932.

**Chief Engineer, Division of Sanitary Engineering, State Board of Health.

malariologi t an assi tant sanitary engineer and a ma laria microscopist The continued cooperation of the U S Public Health Service and Vanderbilt University is gratefully acknowledged

Efforts of the malariologi t have been directed par ticularly to the development of local p ograms of ma laria control the stimulation of more complete report ng of cases of malaria by practicin physicians and in tructions of health officers and other phys cians in the microscopical diagnosis of the disease

Scree ng and Mo quito Proofing—Early in June 1932 a three day screening school for health officers and san tary in pectors was conducted in Shelby Coun ty in cooperation with the Shelby County Health De partment Thirty seven per ons regi tered for the cour e

Major screening and mo qu to proofin activit es were carried on in Shelby and Lake Counties

Drai age—County wide drainage was attempted only in Shelby County This work has been made possible throu h funds comm tted to unemployment relief in Memphis and Shelby County and supplemented by penal labor App oximately 24 m les of new ditches were constructed and 16 5 m les of old ditches clea ed and maintained Engineering con ultation was g en by the State Department of Health

M nor drainage was promoted extens vely in Dyer Lake Obion and Laude dale Countie An assistant sanitary engineer was employed exclusively in this work and the projects were developed largely from the po nt of view of land reclamation

Roadside barrow pit drain ge was continued on state and county h ghways, as cooperati e projects between the Health Department and the H ghway Department of the tate The State Health Department a sumed the duty of locat n the barrow p ts needin drainage and the di ion of maintenance of the State H ghway Depa tment as umed the re pon ibil ty for actual drain age

Impo nded Wate Cont ol—Con ultation ser ce to owners of mpounded water project has been cont nued and during the year mosqu to control has been affected through the u e of oiling of hore lines by means of power boats and through controlling the water level by u e of head gates

Mun pal Mosquito Control—Mun ipal mosqu to control which included d ainage the use of la vacides premi e in pection and creening has been carr ed out in 25 cit es and towns principally in West Ten es ee

Some experiments in mosquito control in lily ponds have been carried out in Memphi using a mixture of pyrethrum extracted in kerosene and emulsified in soap olut on

Hous ng Improvement Prog am—The difficulty of mosquito proofing a large proportion of the types of rural tenant homes found in the South is well known Efforts have been made during the year to develop plans whereby the state and local health departments could assist landowners not only in the construction of better homes for tenants but al o in the scientific grouping of these homes and the selection of building sites with a view to eliminating malar a ha ards Architectural plans together with b lls of materials for a variety of homes have been prepared with a view to the development of a bulletin which will be d strib uted to landowners through the local health department

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MALARIA CONTROL IN VIRGINIA IN 1932*

By G Foard McGinnes M D **
Richmond Va

There ha been a con tant and rather rapid decrease in mala a incidence in Virginia during the past ten years Very little wo k has been done by the State Health Department in the control of this disease re cently as it is no longer one of the major problems Every effort is made to obtain complete and accurate reportin of mala a and any increase in p evalence of this disea e in any commu ty is nvestigated During the pa t yea no uch increases have occurred

E perimental work in mo qu to cont ol has been carried on during the pa t year by the Bureau of Ep demiology in cooperation with the United States Publ c Health S rvice Th s experimental work has been ca ried on with the hope of obtaining an effective and economical larvacide wh ch may be used in the con trol of both the pest mosquito and the anopheline mos quito Some local communities ha e carried on local mosquito control programs directed toward el m nation of the pe t mo quito

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*R d b f N l M l n C mmi t (Co f M l) m t g co jo ly w h S th Medical Associati T ty Sixth A l Meet g B rm gh m Alab m N mber 15 18 1932

**Ep d m l gist Stat D partm t f H lth

The figures for house screening are 1 594 for the year of 1932

The number of examinations made of blood for malaria parasites is 7 468

There were 159 deaths from malaria fever in 1932

The Welfare Association for the unemployed has put to work several thousand men cutting weeds and grass along the highways and we have been able to get these men to open drainage and establish a flow of water as they go along the road

Our experiment with chinoplasm which was reported in our last symposium has proven a success as not a single case has been reported from the neighborhood of our experiment up to the present time

Drainage and ditching work is now being done in the state new ditches being built ditches opened cleaned scraped and oiled and certain lands are being treated with larvicide

Special surveys have been made in a number of northern Louisiana parishes

At present we are draining and building new ditches all through Grand Isle with excellent result

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MALARIA CONTROL IN MISSOURI IN 1932*

By W Scott Johnson **
Jefferson City Mo

I regret to advise that early in 1932 the malaria program in southeast Missouri was abandoned due to lack of funds and consequently there is no report to be made on this activity

In cooperation with the Union Electric Company owners the control program on the Lake of the Ozarks was continued on much the same basis during the 1932 season with substantial improvements however The results of this control work around the lake have been very satisfactory and we believe as far as the shore line of the lake is concerned the work has proven effective in the control of mosquito breeding However due to lack of activity on the part of local authorities there has been notable mosquito breeding above the high water level of the lake in the small tributary streams And at least in one county a number of malaria cases developed from this source It would seem that unless the local communities take a more active interest in the mosquito breeding problem in the water courses above the high water level of the lake a great deal of the effectiveness of the control work on the lake will be nullified

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Sixth Annual Meeting Birmingham Alabama November 15-18 1932

**Chief Public Health Engineer State Board of Health

MALARIA CONTROL IN MISSISSIPPI IN 1932*

By George E Riley M D **
Jackson Miss

With three engineers employed during the six months period January 1 to June 30 1932 and only two engineers employed for the period July 1 to September 30 1932 there were 106 8 miles of surveys made as compared with 145 6 miles surveyed during the twelve months period January to December 1931 when three engineers were employed throughout the entire period There were 72 0 miles of surveys put to grade during the nine months period as compared with 46 0 miles during the period January 1 to December 31 1931 There were 56620 acres of land reclaimed as a result of the drainage work completed The tax assessors of the respective counties estimated that the assessed value of the land affected had increased on an average of $20 00 per acre

A bulletin The Screening and Mosquito Proofing of Houses was prepared by the director of the division of malaria control This bulletin had for its object the enlistment of the cooperation of the division of vocational education of the department of education of the state This agency has been very cooperative in promoting screening projects in 194 Vocational Agricultural Schools including 154 Trade and Industrial School

Screening and minor drainage with special reference to control of anopheline mosquitoes have been a part of the routine activities of the 29 full time health departments

During the nine month period there were reported to the department the complete screening of 322 houses and the installation of 43 standard screen doors An effort is being made to obtain reports from the vocational schools to determine the results obtained through these agencies with special reference to screening activities

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MALARIA CONTROL IN TENNESSEE JULY 1 1931 JUNE 30 1932*

By E L Bishop M D †
Nashville Tenn

General—The program of malaria control in Tennessee for the fiscal year ending June 30 1932 was continued along lines previously employed and certain additional activities were inaugurated by reason of the employment of additional personnel which included a

*Read before National Malaria Committee (Conference on Malaria) meeting conjointly with Southern Medical Association Twenty-Sixth Annual Meeting Birmingham Alabama November 15-18 1932

**Director Division of Malaria Control State Board of Health

†State Commissioner of Health.